1859 FIFTY-NINTH YEAR 1917

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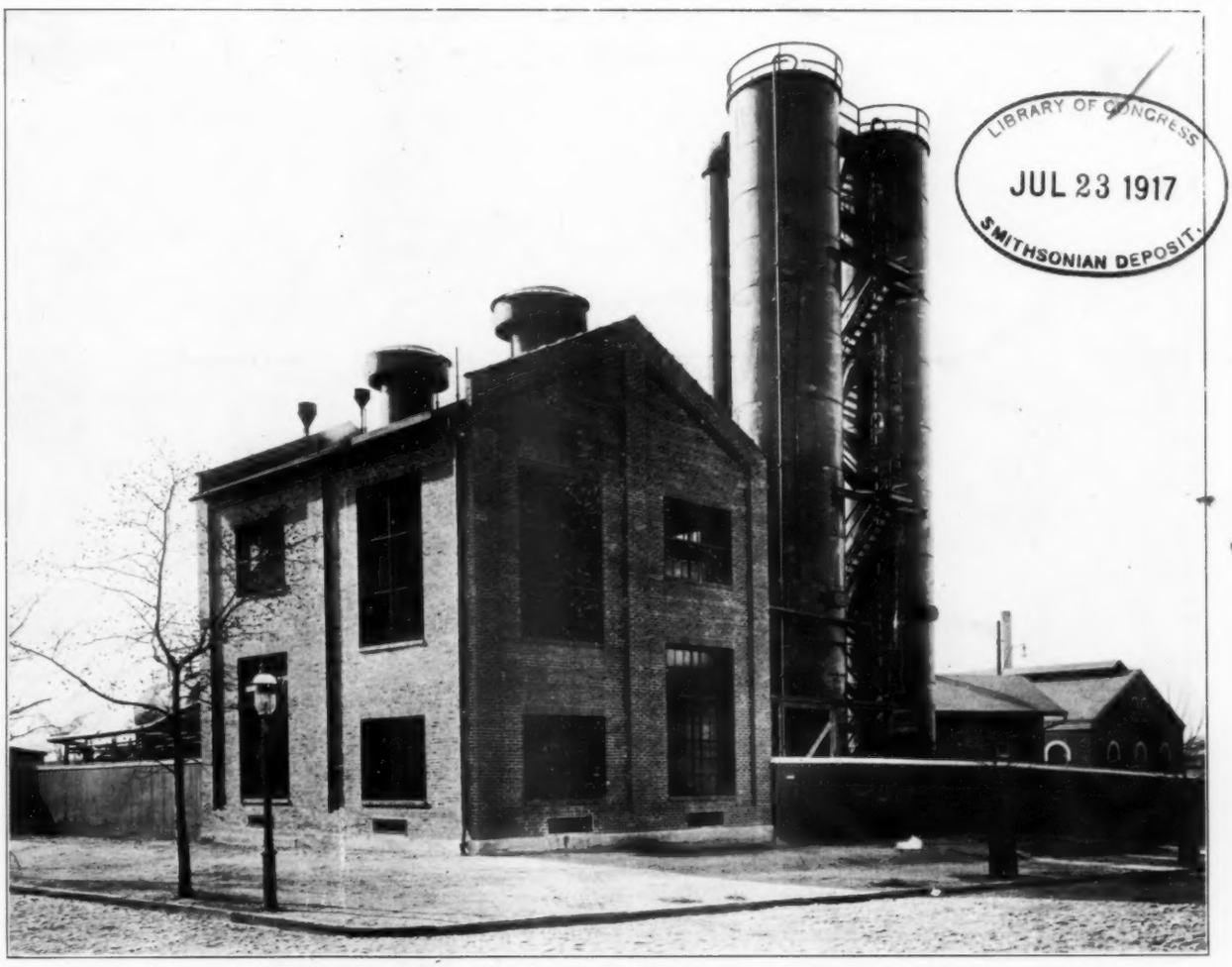

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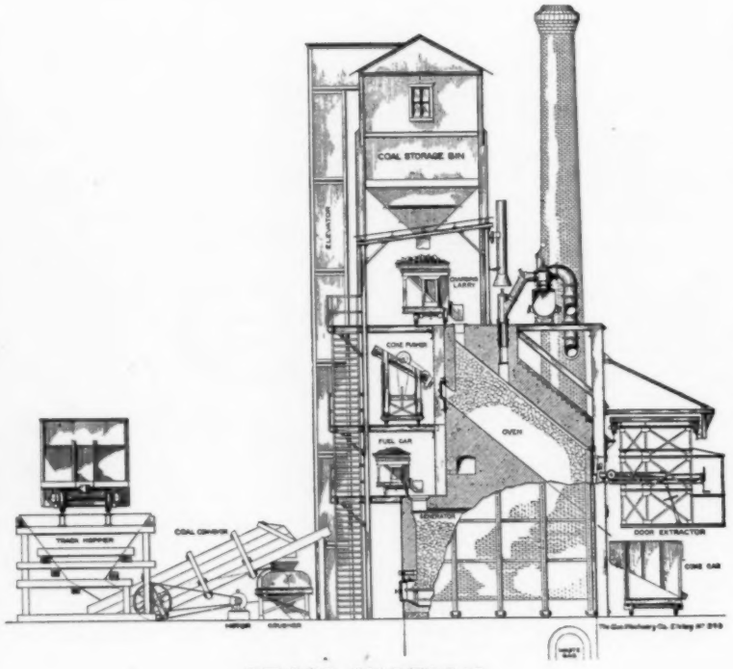

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Vol. CVII, No. 3 NEW YORK, JULY 21, 1917 Whole No. 3098

Producer Gas Takes Place of Oil for Continuous Forging Operation in Buffalo Plant

Temperature of 2100 Deg. Fahr. Obtained Without Regeneration—Gas Averages 150 B. T. U.

By JOHN H. BARTLETT, JR.

Engineering Department, Surface Combustion Company, Long Island City, N. Y.

Producer gas has recently been successfully applied without regeneration to a continuous forging operation in the plant of the Buffalo Bolt Company, at North Tonawanda, New York, a few miles from Buffalo. An installation of Smith Bituminous up-draft producers was made at this plant about a year ago, to furnish fuel for rolling mill and forge shop furnaces, but until the recent equipment of a coil furnace with Surface Combustion burners, its use has been restricted to the rolling mill.

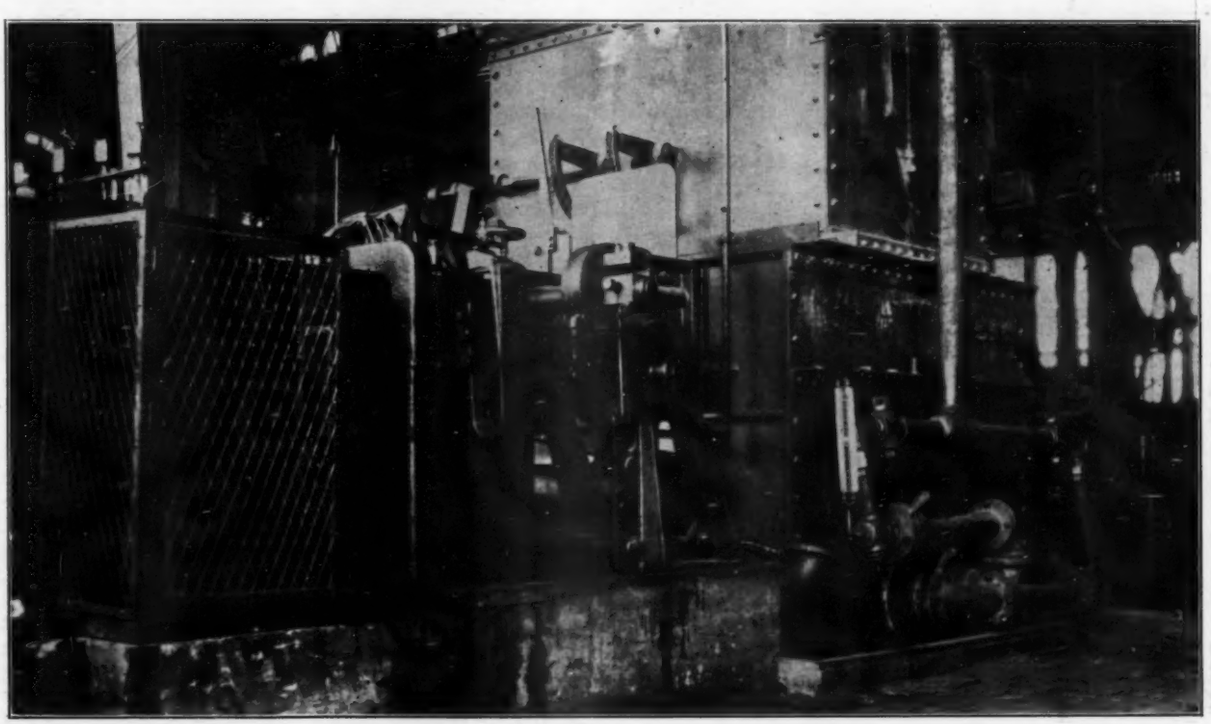


FIG. 1. HEADER MACHINE AND COIL FURNACE

Bolts of standard sizes up to ½ in. that are manufactured in large quantities, are forged by a group of five continuous header units of the Buffalo Bolt Company's own design. Each unit consists of a bolt header machine, which heads and cuts off a bolt at each revolution, and a coil furnace from which stock is fed continuously to the machine. (Fig. 1.) This method of making bolts was invented and developed by W. B. Pierce, general superintendent, with a view to rapid and economic production, and each unit is capable of forging about 85,000 bolts per 9-hour day. The iron is fed to the furnace in the form of wire coils of about 30 in. diameter by a revolving drum device (Fig. 2), which forms the back of the furnace and is driven by an electric motor. Inside the furnace the coils hang over a water-cooled arm and one by one are pulled off, straightening as they are drawn out through a small opening in the front of the furnace by the machine feed. The process is made continuous by electrically welding together the end of the coils before they are fed into the furnace. By this means a considerable amount of wire is always in the furnace, allowing ample time for the metal to come to a uniform heat. The furnace is approximately 5 ft. long by 5 ft. high by 4 ft. wide, inside dimensions, and, with the largest size stock the metal is forged at a temperature of 1800 to 1900 deg. Fahr.

FIG. 2. REAR OF FURNACE WITH DRUM FEED AND PIPES FOR WATER COOLING

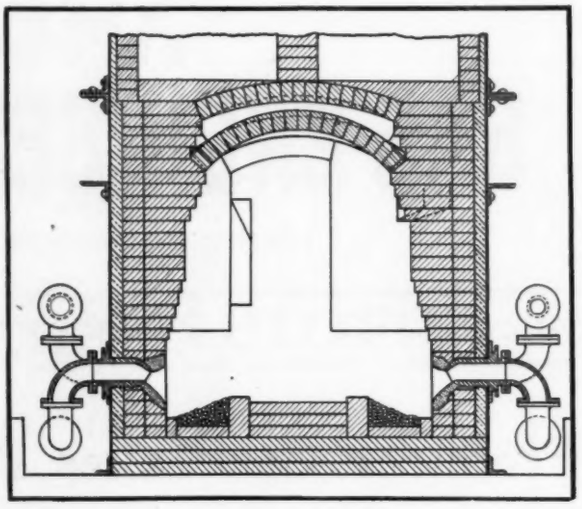


FIG. 3. DETAILS OF FURNACE

Previous Attempts to Apply Producer Gas Fail

Previous attempts to fire these furnaces with producer gas proved unsuccessful in obtaining a satisfactory temperature, although checker brick regenerators were installed. Oil fuel has heretofore been used which, however, is more expensive than the gas, and at high temperatures produces an objectionable scaling of the iron.

One of these furnaces has now been equipped with four gas burners of special design by The Surface Combustion Company, of Long Island City, N. Y. Each of these burners is provided with a proportioning inspirator, which utilizes the pressure of 8 oz., at which the gas is supplied from the main to entrain the necessary air for combustion. This mixture of air and gas, passing through the air-cooled burner castings, is baffled and burned in a refractory bed of broken carborundum, which insures proper combustion and radiates heat to the walls and arch of the furnace. A cross-sectional sketch of the furnace construction is shown in Fig. 3, and details of the inspirators and burners in Fig. 4 and 5. Gas is supplied by the control cocks CC to nozzles in the inspirator bodies AA. Air admitted through the inlets II is entrained by the gas through the Venturi throats VV, in which the air and gas are thoroughly mixed before passing to the burners BB. FF are flanges for air-cooling the burners.

The gas consumption and furnace temperature are controlled by the cocks CC, the air entrained being at all times proportional to the amount of gas supplied. The shutters or dampers DD, shown on the air intakes, are provided to accommodate variations in the gas quality, and, when lean gas requiring less air for combustion is supplied, they are partly closed. The water gauges W, showing the pressure to which the gas is throttled, afford an index of the consumption of each burner. When it has been determined, through operation, that a certain pressure is sufficient to maintain the heat when working on a certain size of wire, this burner capacity can always be quickly duplicated from the pressure gauge reading without guessing at the proper setting for the control cocks.

Keeping Scale on Metal at a Minimum

To keep scale on the metal at a minimum, the burners are arranged to operate with a slight excess of gas, and, when running the furnace at high temperature with this rich mixture, the oxidation has been found to be considerably less than the best results obtained with the oil furnaces. The metal also appears to be somewhat softer, probably due to a more thorough heating through, and is easier to work.

It is regretted that no exact comparison of operating costs with oil and gas can be made, as accurate data on the amount of oil consumed and the cost of the gas are lacking, but a rough estimate was made as follows:

Average oil consumption, 20 gal. per hr. @ 5c. = $1.00
" gas " 20,000 cu. ft. per hr. @ 3c. M = .60

The calorific power of the gas fluctuates somewhat, but averages about 150 B.t.u. per cubic foot.

The machines are operated 9 hours per day, and the furnaces are started about an hour and a half before work is commenced. Sufficient burner capacity is provided to bring them up to 2,100 deg. Fahr. in this time.

It is believed that a substantial economy can be affected over the present operation by recuperation, and plans are under consideration for preheating both the air and gas in steel chambers placed above the present flue outlets in the casing formerly used for the checker work regenerators.

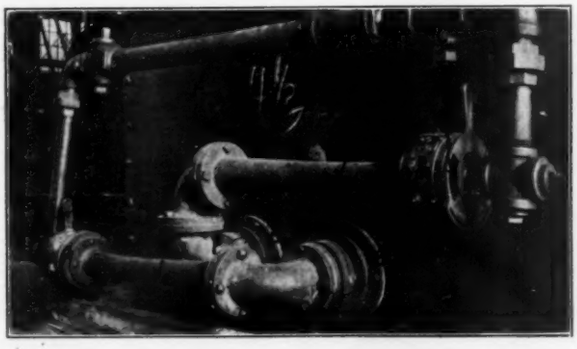


FIG. 4. DETAILS OF BURNERS AND INSPIRATORS

Owing to the satisfactory operation of the burners described above, duplicate equipment for two more coil furnaces has been ordered and other producer gas burners are at present being made by the Surface Combustion Company, to equip a large vertical annealing furnace for the Buffalo Bolt Company. This will have eight burners located to give a uniform heat to all parts of the furnace, each two burners having an inspirator similar to those used on the coil furnaces. Where it is desirable to use smaller burners a single inspirator may be used to supply a number of these through manifold piping. As a device for correctly proportioning and mixing air and gas the inspirator is simple and reliable, and has no moving parts that can be damaged by back fires or choked by tar and mixture carried in the gas.

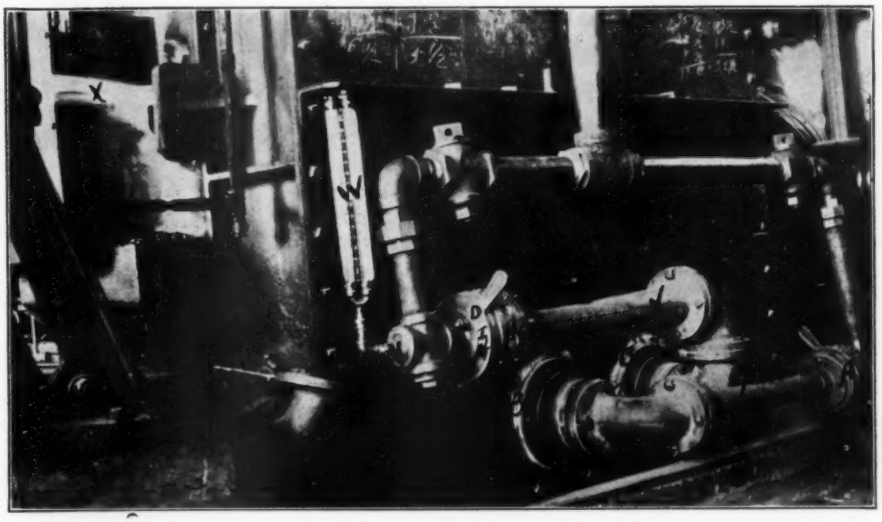


FIG. 5. BURNERS AND INSPIRATORS—WIRE BEING DRAWN OUT OF FURNACE AT X

Producer gas burners are also being designed for use in a tong-header furnace, to replace one of the present coal fired forges. This operation consists of heating the ends of small rods for heading in a hand-fed machine, and is used for bolts of sizes other than those handled profitably in the coil machines. In this forge the ends of the bars will rest upon the top of the refractory material in which combustion of the mixture of air and gas takes place, and they will thus be close to the source of heat, duplicating the conditions in the coal forge. The furnace will be fired by six burners equally spaced along the rear, and connected alternately through two manifolds to inspirators as on the annealing furnace.

Business in Wartime

The business men's slogan during the war should be "No panicky saving and no excessive profits." Business should be kept active, employment should be abundant, wages should be high.—Otto H. Kahn.

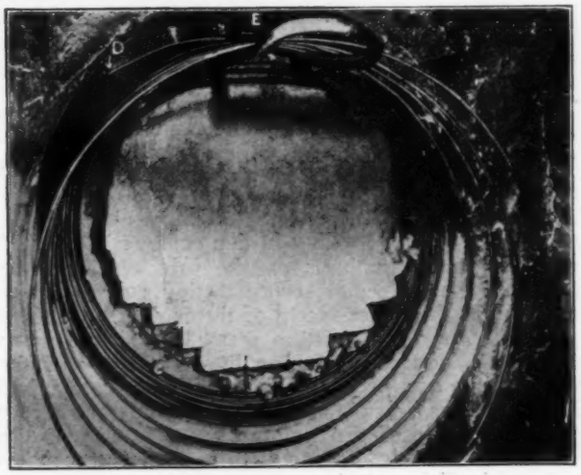


Photo Courtesy, Iron Trade Review.

FIG. 6. WIRE ENTERING FURNACE

Twenty-Five Per Cent of Coal Mined Last Year Wasted Through Inefficient Use

Van H. Manning Reveals Startling Conditions—Certain Amount of Care in Engine Room Would do Much in Way of Conservation

Fully half a billion dollars, or one-fourth the issue of the Liberty Loan bond, was wasted last year in this country through the inefficient use of coal, according to Van H. Manning, director of the U.S. Bureau of Mines. He further declares that this waste is continuing at an even greater rate and at a much larger penalty to the country because of the increase in the price of coal. "The penalty is not only a heavy tax on the American pocketbook," says Mr. Manning, but it is also an unpatriotic thing, for every pound of coal we waste there is that much less available to put into energy to end the war.

Greatest Production Ever Witnessed in World

"Last year the United States mined six hundred million tons of coal, the greatest production ever witnessed in the world, and of this amount we wasted one hundred and fifty million tons, or twenty-five per cent, through inefficient use.

"As an example, in the modern, efficient power plants of the country twenty per cent of the heat in the coal consumed is converted into power, whereas in the small power stations the efficiency frequently drops below ten per cent. Although the average efficiency of all kinds of steam-power plants in the United States can be only a matter of guess-work, it is quite probable that the average is somewhere in the neighborhood of five or six per cent of the energy of the coal transformed into useful energy ready for distribution. So you can see that, if it were possible to elevate the average efficiency to something near the maximum now attainable in steam plants, about three times as much energy would be available for the productive industries of the country.

"You will find business men, however, making the statement that in order to attain these savings it will be necessary to put in new equipment, and that this is not the time for changes with the factories working at their maximum to supply the materials needed in the war. This is partly true, but there is hardly a manufacturing establishment in the country which can not, with a certain amount of care and supervision in its furnace room, use much less coal and obtain much greater results.

Burning of Fuel No Simple Process

"Owing to the great abundance of coal here, in the past the manufacturer has paid but little attention to the amount of coal he burned or how it was burned. In addition, technical training in our colleges has placed relatively small emphasis on the principles and the processes of combustion, concentrating their attention rather upon the improvement of the engine. The more evident facts of combustion seemed so simple as to offer little inducement for an intensive study of the process, but, as a matter of fact, the burning of a fuel is by no means a simple process, and the misconceptions that have resulted from a too casual study of the phenomena have led engineers to construct uneconomical and inefficient devices.

"The nature of coal has also been misunderstood by many users. Coal is an extremely complex substance, behaving quite differently under different conditions of combustion, and as the United States is extremely rich in a great variety of mineral fuels, it would seem necessary that the furnace design should vary with the different fuels used.

"The Bureau of Mines has for a number of years been engaged in studying these problems and has by this time completed a number of reports that tend to solve many of the difficulties met with in the burning of coal. These reports are not only of extremely great value to the engineers and firemen of power plants, but they are also a practical aid to the householder in keeping up his furnace in an economical manner. Many of the conclusions of the bureau, as embodied in these reports, can be put into operation at once with a great saving of coal and without any expensive new equipment being installed.

Substitution of Coke for Anthracite Coal

"Looked at in a broad way, it is not economical to transport high-grade coal through long distances into districts where fuels of lesser value are to be had in abundance, when, as a matter of fact, the cheaper fuels could be satisfactorily used if the user would show a little patience and gumption. The suitability of fuels for use in any locality is, therefore, a matter of public education in which the Bureau of Mines takes a deep interest. As an illustration, the substitution of coke for anthracite coal in many localities is very desirable on the score of economy, and the bureau desires to stimulate the use of coke as a domestic fuel because of its cleanliness.

Advocates Unquenched Gas Works Coke for Generation of Electricity

In order to combine the economy of the coal carbonizing process and the operation of electrical generation, so that the highest degree of the economical use of bituminous coal may be fully realized, the co-ordination and *pro rata* development of the basic industries of fuel and power supply may ultimately become necessary in view of the vital industrial and defensive importance of adequate and cheap supplies both of fuel and power, writes E. W. L. Nichol in the *Electrician* (British).

The sensible heat unavoidably wasted by the quenching of "horizontal" gas coke represents a considerable proportion of the total heat used for carbonizing the coal, which, if it could be used for the purpose of steam raising, would appear to offer attractive possibilities in a combined fuel and power supply center, laid out with this end in view. By thus utilizing the sensible heat as well as the combustion heat of surplus gas coke in a suitably constructed boiler furnace a considerable saving in fuel would be effected, as well as economy in transport and in many other directions.

Consideration of these features might form a starting point for the development on a working scale of an experimental boiler and furnace for use with coke as fuel.

Whatever the merits or demerits of any such scheme may be, more immediate interest will be centered upon adapting existing steam generating plant to the use of coke as fuel. So far as hand-fired boilers are concerned, experience has shown that, with few exceptions, existing types are more or less easily adaptable.

By-Products of Gas and Coke Production Serve All Essential Branches of Wartime Activity

C. W. Hunter Points Out Their Relation to Such Important Branches as Transportation, Food Production and Munitions

EDITOR'S NOTE: *So much has been said of the important part of the by-products of gas manufacture in the production of munitions that many of us have almost forgotten or minimized the importance of the fact that our by-products are essentials to other branches of wartime activity, which are just as necessary to the successful conduct of war as the supply of munitions. C. W. Hunter, gas engineer of the Stone & Webster Engineering Corporation, gives an excellent presentation of this broader relationship of the gas industry to the nations at war in the July journal of that firm. The following has been abstracted from this article:*

The maintenance of the fighting power of an army in the zone of operations in modern warfare demands a transport system possessing speed and reliability surpassing all previous conceptions. This has been worked out in Europe by the adoption of the motor truck, which has been used in such great numbers that the consumption of fuel for army transport alone is enormous. In countries which do not produce petroleum from which gasoline may be made, it is necessary to turn to some other source of supply.

GAS PLANTS HAVE SAVED GERMANY TO DATE

Also, the factor of the productiveness of the soil of the various belligerent nations, has reached a point of paramount importance. In the densely populated countries on the Continent, whose soils have been intensely cultivated for centuries, the need of artificial fertilization is imperative.

In each of these three fields of usefulness in wartime many of the necessary raw materials or finished products are produced in the industry of the manufacture of gas and coke.

From it are obtained the bases of several of the most important high explosives, a motor fuel containing a greater power for a given bulk than gasoline, and a fertilizer containing a high percentage of available nitrogen, besides many other materials less directly applicable to military operations. It seems not too much to say that without its gas plants and coke ovens, Germany would have been forced to terms long ago.

From the standpoint of the technique of their use, modern explosives are divided into three general classes, propellants, blasting powders and detonators.

MAKING PICRIC ACID

By-products from the manufacture of coal gas and to a less extent water gas, from the base of a number of explosives of the second class mentioned. An explosive reaction is of the same general nature as ordinary combustion and an explosive mixture or compound must contain two essential ingredients, an oxygen supplier and a combusible. When such a substance contains these components in the proper proportion to form the ordinary products of combustion and has at the same time a weak molecular structure due to the presence of a substance of weak molecular bonds, it may become an explosive. In gas made by the modern process of distillation or coking of coal in by-product ovens or gas retorts, there occurs in the form of vapor the series of hydro-carbon known as the "benzols" which contain the combustibles, hydrogen and carbon. If these materials are treated in the proper manner with nitric and sulphuric acids, they form chemical compounds containing the "radicle" NO_2, which has an exceptionally weak structure and will give up its oxygen at a sufficiently rapid rate to cause the compound to explode with powerful effect when the reaction is initiated by the proper condition of heat, shock, etc. From a military point of view the most important explosives formed from the "benzols" are picric acid and trinitro-toluol, usually termed T. N. T. in this country.

Picric acid is manufactured by nitrating phenol, one of the components of coal tar. In time of war, the production of phenol from this source would be too small to meet the demand, and consequently synthetic phenol is made from benzol, which is recovered from illuminating gas by absorption with a high boiling point oil possessing certain characteristics.

MUST STAND SHOCKS AND JARS OF TRANSPORTATION

Picric acid was first used as an explosive in 1871; it was known as a poison and a dye long before its explosive properties were recognized. Its chief advantages for military purposes are its powerful effect, and when pure and properly used, its stability and insensitiveness. The modern high explosive which is to be used as a bursting charge for shells must be able to meet very rigid requirements—in fact, some of the characteristics demanded seem to be almost contradictory. For instance, while it must respond at the proper time to its own fuse the explosive must be able to stand without detonation the shocks of handling and transportation and also those of the discharge from the base of the gun and impact of the shell on the obstacle. The not unusual popular idea that the usefulness of a powder is measured by the ease of detonation is misleading. Many explosive substances are not allowed to be transported on railroads on account of their sensitiveness and are therefore eliminated from service.

One of the objectionable characteristics of picric acid is its property of combining with metals, especially iron and lead, to form "picrates" which are very sensitive. This makes it necessary to coat the inside of shells, which are to be filled with this material, with non-metallic paint; obviously, if this is not properly done and the filler and shell are brought in contact, sensitive compounds may be formed which may prematurely explode and in turn detonate the charge with disastrous results. Another objectionable property of picric is its high melting point (about 250 deg. Fahr.) As it is usually desirable in filling, to melt the material and pour into the shell in order to secure greater density of loading and consequently increase the explosive effect, a substance

with high melting point entails certain risks in handling. While picric may be decomposed by heat into vapors which may be burned without exploding if properly manipulated, a sudden application of a large amount of heat is apt to set it off. To eliminate this danger, various substances have been mixed with it to reduce its melting point, the compounds forming the service high explosives of various nations under the name of Lyddite, Melinite, Schimose, Ecrasite, etc.

T. N. T. a Close Cousin to Benzol

Tri-nitro-toluol, which is manufactured by nitrating toluol, a very close cousin to benzol and occurring with it in coal gas and water gas, does not possess some of the dangerous features of picric, and therefore has come in favor in recent years. Its melting point when pure is about 147 deg. Fahr., it does not give off noxious fumes when melting, is less sensitive than picric and does not form compounds with metals, so that it may be used directly as filler for high explosive shells without special preparation. It is not as powerful as picric, but this is claimed to be an advantage under the supposition that the former blows its shell into minute pieces which are too fine to be effective as *shrapnel*.

Many attempts have been made to utilize the explosive qualities of the "picrates" or compounds of picric acid, the only one which has met with any success being ammonium picrate, which is stable and comparatively insensitive. In the case of this material, not only the base of the picric acid, but also the ammonia, is a direct by-product of coal gas. Its property of absorbing moisture, which lowers or completely destroys its explosive character, has limited its use to mixtures with other ingredients. It was reported in the papers recently that the largest military mine prepared so far was set off by the British in the battle of Messines Ridge, the explosive used being "Ammonal" which is stated to be a mixture of ammonium picrate and powdered aluminum with other minor substances, the aluminum being added to prevent the absorption of moisture.

Effect on Gas

It may be remarked that benzol and toluol are important constituents of illuminating gas as they are responsible for a large part of its illuminating power and to the extent of perhaps 5 to 7 per cent of its heating value. When the gas is generated in coke ovens and used for heating the ovens themselves or in the process of steel manufacture, the reduction in quality is immaterial to the company as compared to the value of the benzols as by-products. When, however, the gas is distributed to the public under state requirements as to its heat value or candlepower if the benzols are removed, it may be necessary to re-enrich it, or to arrange for some modification of the quality specifications.

In this country, up to a short time ago, practically all of the benzols used for explosives were recovered from coke oven gas not subject to public use. Any great increase in the demand would mean that all gas companies of moderate size or larger would have to install apparatus for the recovery of toluol and possibly benzol—in fact, a few of the larger undertakings have already done so.

As re-enrichment of the gas is an expensive matter if it is necessary in a time of national emergency to abstract these materials from city gas, some adjustment will have to be made between the gas companies, the consumers and the government. It would seem that in anticipation of such an emergency, a start should be made on the settlement of this question. While most of the English gas companies are now recovering benzols, it was only after such discussion and not until August, 1916, two years after war was declared, that Parliament passed an Act containing provisions by which any gas company operating by virtue of a Parliamentary order could legally apply for a change in its standards so as to permit extraction of benzol.

Selling Benzol in Competition with Gasoline

Besides being a base for several modern explosives benzol finds a direct application in war as fuel for engines of motor trucks for army transport, etc. It is stated to yield 25 per cent more power than gasoline. In the United States, the development of the petroleum industry has made gasoline the practically universal motor fuel. As early as 1910, however, it is reported that one-half the benzol output of Germany was used for this purpose and during the war it has been indispensable to them. Since 1914, many benzol recovery plants have been installed in the coke oven and gas plants of this country, and in many, if not all cases, the cost of the plant has been written off out of the profits received during the period of high prices. When the war ends, these will be idle unless a market is developed for their output. Under the existing conditions, it is not unlikely that benzol can be sold at a price which will compete with gasoline and that it will be largely adopted as a fuel for commercial trucks, if not for pleasure cars.

It is curious that nitrogen, the practically indispensable agent in the formation of many explosives by which men destroy each other, is also the indispensable element for the nourishment of plant life, by which men live. The present war seems to be developing into a contest of food production and again the by-products of the gas industry are of assistance to the nations by furnishing nitrogen available for the intensive cultivation of the soil, in the form of ammonia. In the process of generating coal gas, part of the nitrogen of the original coal combines with hydrogen and appears in the gas as ammonia, which may be readily recovered by absorptions with water. Usually the ammonia is treated with sulphuric acid to form ammonium sulphate, which is the principal nitrogen bearing component of many fertilizers. The amount thus furnished is not by any means sufficient to supply all the needs of fertilization but it forms an important part of the nation's supply.

There are many minor uses for coal gas by-products which are directly or indirectly needed in war as well as peace, such as the nitration products of naphthalene as ingredients for "safety" explosives, other applications of benzol derivatives for the same purpose, the many drug dye gases, preservatives and building materials made from coal tar, etc. It seems hardly necessary to mention the importance of coke in the manufacture of steel and the necessity of gas for many domestic purposes as well as industrial heating processes, especially in munitions manufacture. It would seem, however, that one of the characteristics of the business is its adaptability to peace or wartime conditions; in the list of "occupations" indispensable in the conduct of war it can claim a place among the first.

Tire Heating by Gas

Advantages of Gas for This Class of Work Such as Would Seem to Make Replacement of Other Means a Simple Task

By GILBERT C. SHADWELL

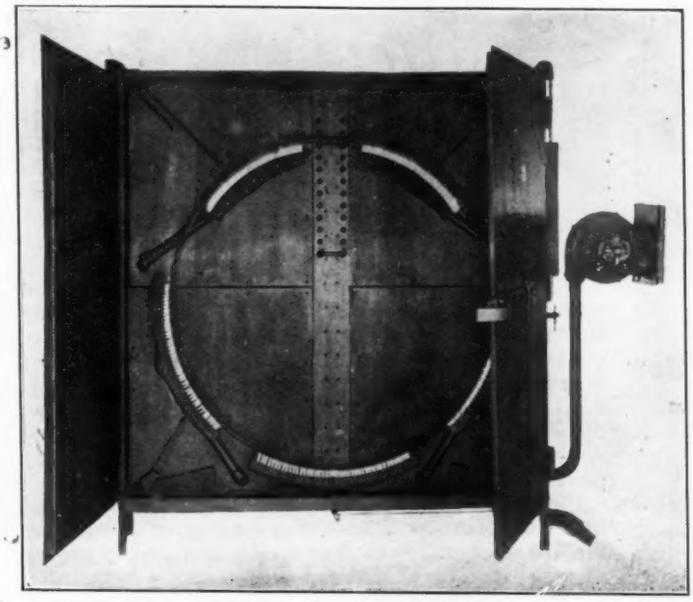


FIG. 1. TYPICAL FORM OF CABINET TIRE HEATER

Wherever a tire is to be put on to a wheel it must be expanded so that it will slip over the wheel and then contract sufficiently so that it will retain its grip on the wheel. The process is usually known in the blacksmith trade as "shrinking on."

Wagon tires, certain large automobile tires, locomotive tires, as well as a number of steel bands, etc., are shrunk on to wheels and other parts of machinery in this way.

The method usually employed is that of heating the tire or other part and then, after slipping it squarely over the wheel, to allow it to cool down and thus contract so that it will grip and remain on until required to be removed for renewal or other purposes, when it is again heated in order to expand it for that purpose.

Hydraulic pressure with or without heat is also employed to quite an extent in some work of heavy nature, but need hardly be considered in this article.

Heating Wagon Tires

In Fig. 1 will be seen a typical form of cabinet tire heater. The illustration, however, hardly gives any adequate idea as to the size of the appliance, the details of which are seen in the following tabulation:

Outside Dimensions			Maximum	Shipping
Width	Height	Depth	cu. ft. gas	Weight
68″	79″	14″	500	450 lb.

Operating Data

The power required for the fan motor blower is almost negligible.

The gas consumption being at the rate of 500 cu. ft. per hour we need at least 6x500 or 3,000 cu. ft. of air per hour *delivered at the burner ports* to obtain proper combustion.

Test Under Actual Operating Conditions Gives Idea of Time That Can Be Saved

The following data, obtained under actual operating conditions, probably represents average results. They will give a fair idea of the time saved, and the low cost of operation, and might be easily improved upon under more ideal operating conditions.

No. of Tires at one time	Diam. of tires (inches)	Width (inches)	Thickness (inches)	Time to heat (minutes)	Gas used (cu. ft.)
2	48	2	⅜	10	74
1	60	4	1	24	186
1	48	2	⅝	8	61
2	30	2½	¾	14	97
1	42	3	1	13	98

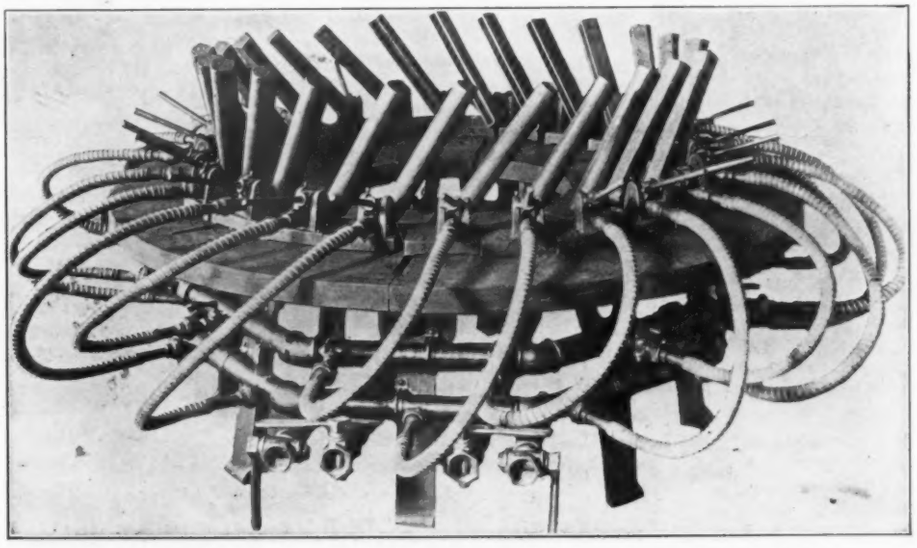


FIG. 2. ONE ARRANGEMENT POSSIBLE WITH AN AUTO-TRUCK TIRE HEATER

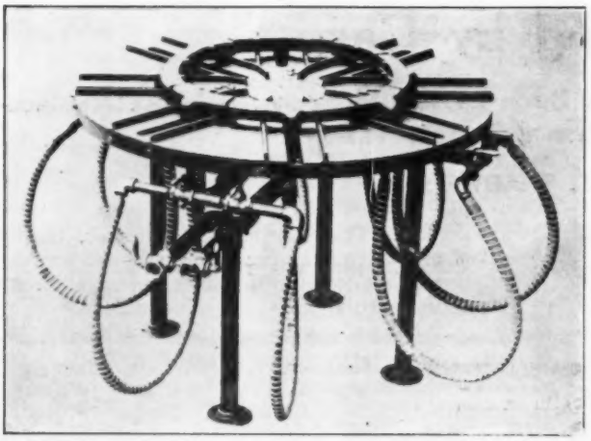


FIG. 4. BAND HEATER WITH POSITIVE PRESSURE AIR BLAST

Bear in mind that the idea is not necessarily to heat *all* the tire to *all* the same heat, but to heat it locally or in spots or entirely *so that it will expand sufficiently* for the purpose in view.

Several types of tire heater are in common use to-day, but every point in connection with their utilization is similar whatever style of heater is used.

Costliness of a Fuel That Costs Nothing

In the old days—in fact, to-day—in many places wood is the fuel used to heat up tires. It is carried out in the wheelwright's yard, old crates and boxes " which cost nothing?" They cost the whole building some times, especially when a spark blows away on to the wheelwright's frame structure. In some cities and towns there are ordinances in force absolutely prohibiting the use of unprotected and uncontrolled wood fires in a yard for carrying out this or any similar work. But even if there were no fire hazard at all how about the time taken to do the work?

Supposing a customer comes along and wants a tire on in a hurry? Has he to wait several days until the wheelwright has sufficient orders to make it practical for him to get together his refuse material and light a fire and so heat up a dozen tires or so at once?

That way of doing things may have been all right 100 years ago, but it is hardly in keeping with modern conditions.

Service to-day is all-important, and is worth many dollars to those who can provide it as well as those who require it.

Wood fires in a yard can usually be used on clear days, when there is no rain and in daylight.

Gas is available at any time—day or night; sunshine, rain or snow; winter or summer.

Auto Truck Tire Heating

In the case of automobile truck tire heating the work formerly required the gas man's attention to almost its entire extent, but recently modifications in automobile truck tire designs have been made. Nevertheless, several manufacturers put out horizontal tire heaters for this and similar work.

Figs. 2 and 3 show the arrangements possible with such a tire heater—a small or a large one, wide or narrow.

Closely allied to the tire heater is the band heater operated with positive pressure air blast shown in Fig. 4. The bands to be heated are placed in the center and the burners are adjusted to suit the diameter of the band in the same way as the horizontal tire heater already described.

Fig. 5 shows an automobile tire heater and also a band heater in operation. This shows the method of inserting the tire. An examination of the illustration will convey far more than is possible by words of explanation.

One form of locomotive tire setter is usually arranged vertically and flames play around it. The work is sometimes accomplished with gasoline, but this is very inefficient and is also expensive. Probably the best way is to utilize a circular manifold into which are inserted single port burner heads. This method gives a refractory heat which is most satisfactory and speedy for this work.

The heating of various tires and bands, however, is by no means confined to the appliances named.

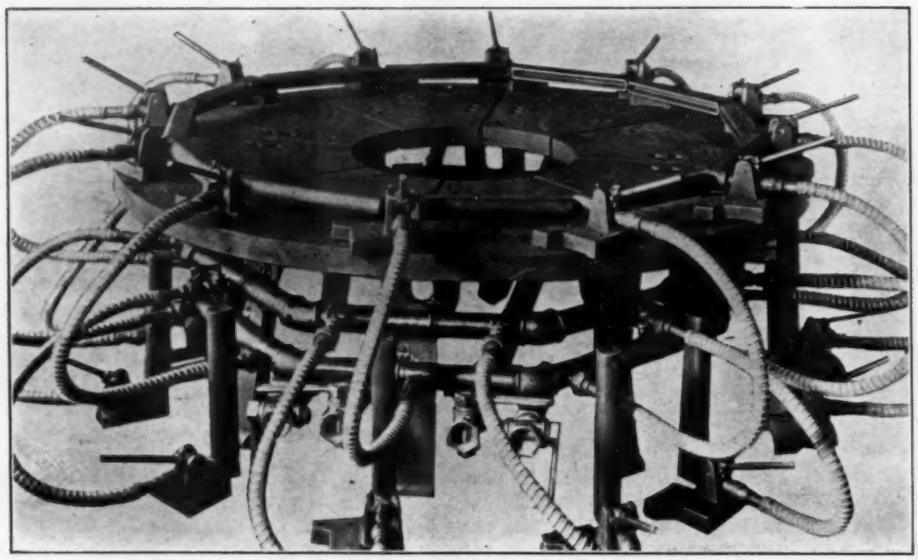


FIG. 3. ANOTHER POSSIBLE ARRANGEMENT WITH AUTO-TRUCK TIRE HEATER

Other Means of Heating Tires by Gas

For instance, an oven furnace may be used but is not to be recommended if high efficiency is desired and only a few are to be heated at a time.

Then a heater may be arranged in such a way that the revolving supports are placed at the bottom on which the tire can rest.

Burners may be placed at the bottom so that all parts of the tire or band will be heated as it revolves.

Such an appliance is satisfactory when the tire or band is not liable to damage by slight unevenness due to the revolving, but is not recommended

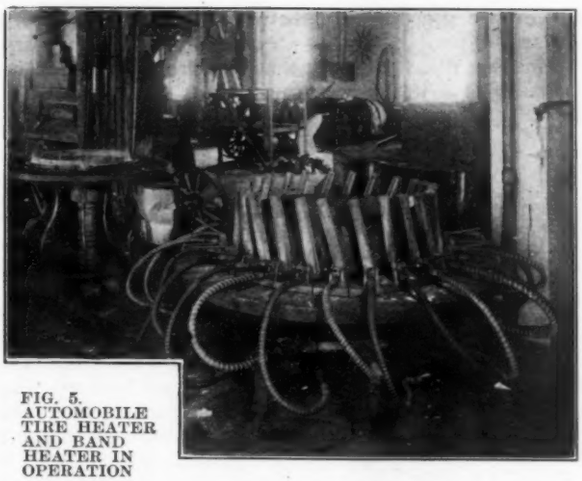


FIG. 5. AUTOMOBILE TIRE HEATER AND BAND HEATER IN OPERATION

if a perfectly round product is absolutely necessary.

It is very important that proper care be taken to see that a large enough gas pipe be run to the heater.

Education and Experience of Engineer Especially Fit Him for High Administrative Positions

H. M. Kistler Sees a Bright Future Ahead for Engineer in the Business Life of the Nation

Only a brief look into the past and a comparison with the present is necessary to reveal the modern tendency of business operations. Corporate life, now seemingly as permanent as human life, has a desire to develop itself more fully, to extend its territories, to expand its powers, and this desire is being greeted with such success that it can only continue indefinitely, declares H. M. Kistler in an article in the July *Monad*. It is contended that at some time the spirit of co-operation might be received more favorably and might tend to replace capital in corporate control to a certain extent. However this may be, the result would be the same—big business.

Characteristics and Requirements of Big Business

Now what would seem to be the characteristics and requirements of a big business? These will be enumerated generally and briefly: It must have a board of keen executives; it must have a well-developed, highly specialized staff organization; and a well trained, efficient line organization, the two of them moulded to work in perfect harmony. For its operation and life it would require structures and machines which up to this time have not been approached in size or efficiency of operation and design. The very nature of a big business calls for these things as prerequisites.

It might be asked now, "Will the engineer be found in or connected with these operations?" Most assuredly he will, and to a much greater degree than ever before. Trained in daily contact with exact and inexorable laws, he is fast becoming more and more a leader in large affairs, he is fast taking his place at the head, and close to the head, of the great industrial concerns, and this he will in no wise cease from doing. He will not replace men of other professions, for men bred to the law and men trained in business will always rise to the top, but here is the contention—the education and experience of an engineer especially fit him for high administrative positions not now commonly thought of as engineering work.

This is the commercial engineer upon whom we have gazed. Now will the big business maintain such a staff organization that the day of the consulting specialist will have passed? No; efficiency would forbid. True, the staff man will be a specialist, but the various phases of each branch of engineering are now being developed to such a degree that the staff man cannot keep pace with them all. He must call upon the specialist who is engaged only in that practice, or in that practice along with one or more allied practices.

Staff Organization Even of Small Concerns Will Have Engineering Representation

From the picture drawn the positions that may be occupied by the engineer will now be selected. In the line organization of the big business the young engineer may be found as a lieutenant in any of the various departments—operation, construction, design, sales, etc.; and continuing up the line, the older man may be found in almost any place, with the departmental manager's or president's chair as his goal. This tendency is developing to-day, and with the increase in big business it can only become more pronounced. The very nature of the staff organization, on the other hand, requires that a part of it shall be composed of engineers, each one specialized in his particular line. Then, too, working with the staff and line on unusual problems will be the consulting specialist.

In a crowd there will always be found tall men and short men, and so along with the big business there will always be the smaller concerns. These, too, will require their engineers, not so highly specialized, but differing from their big business brothers only in that respect. All other characteristics to be set forth later will obtain. These engineers will be drawn from the big business organizations and so no more will be said of them here.

The positions of engineers of the future have been taken up and now an endeavor will be made to analyze the qualifications of the men who are to occupy these positions.

Specialization the Demand of Big Business

It would seem that the engineer, in any phase, must be highly specialized. This is the demand of the big business. Specialization is one of the engineering branches, in administration, sales, operation, what not. Now, how can the future engineer best be trained for this?

The life of the young engineer seems to divide itself into two distinct periods: First, that portion up to the time of his graduation from the technical high school; second, that part of his professional career in which he is fighting for his place in the game. It now seems pertinent to discuss the training he should have during each of these periods.

Up to the time of the entrance into college of the young engineer, little can be done to prepare him especially for his calling, for often he does not select that until ready for college, and sometimes not even then. Elementary education is now being completely remodeled—the number of hours spent in school is being increased, the courses are made to include shop practicum, etc. This for the young engineer is excellent; but let the work go further. Let the student be taught how to think and concentrate the mind; be given an effective instruction in English; be drilled into accu-

racy in mathematics and in composition; be censured severely for loose and faulty speech, and he will be greatly benefited.

Preparation for Engineering Work

It seems that, because of the freshness, impressionableness and mobility of the student's mind, his day should more nearly correspond with the business man's day, that much of the time wasted in off hours could be used to advantage, and that the student should be worked under pressure—not the pressure of a hopeless mountain of accumulated tasks, but rather the pressure of tasks possible of accomplishment. Again, it appears that of many subjects pursued, foreign languages could be the most readily spared. English, on the other hand, should be improved, and radically so. This we hear from all sides, from all engineers.

Another point of discussion is the length of the course. There are many pros and many cons, and all substantially upheld. And along with this comes the criticism of the nature of the course. Is it too highly specialized, too broad, or what? The following remedial plan is proposed for the future engineer: Make the course leading to first degree of four years' duration, and have it broad, offering in that time, very thoroughly, the fundamentals of engineering and a certain percentage of cultural subjects, with plenty of English. Then have two years of practical engineering in contact with the world constitute a preparation for a post graduate course, consisting not of highly specialized subjects, but of a thorough instruction in the specialized course now hurried through, as electives, etc.

By this time the student may have chosen his particular branch, he will have arrived at more mature judgment, and he will be appreciative of the work before him. Thus it would seem that the following advantages might obtain: The student would receive a thorough education in fundamental theory and a better preparation for his future work by virtue of his cultural subjects; he would be required to spend no more than four years in college unless he so desired, thus eliminating any possibility of injury that might come to him because of a longer term spent there; he would have a conception of practical engineering before entering upon its study; he would have the advantages of post-graduate work open to him; and by having the first degree mean less, and the second more than they now mean, he would have an incentive to pursue the advanced course.

Student Co-Operation

Further, the author desires to recommend a larger use of the "Big Brother" movement in college as a means of giving the poorer man a lift, as well as a means toward the growth of the giver. Very often there may be found, in the higher years in college, a man whose English is deplorable, a condition, sad to relate, which instructors often ignore and overlook. Here is an opportunity for helpfulness in which a little tact and diplomacy will work wonders. Again, at a certain college the members of a particular society constitute themselves student advisors to engineering freshmen, calling on them, helping to arrive at conclusions, trying to have them come to a fuller realization of the value of college days and work. This plan has been instituted so recently that its success is uncertain. Perhaps the results will never be direct and visible, but surely the motive is admirable. It might be said that a man grows in proportion as he touches life. The problems that here arise surely cannot fail to be of benefit to the young engineer.

The young engineer walks with diploma in hand into his second period. He has a vague idea of life, industry, business. What now must be his preparation for his position as a future engineer? It is assumed that he has a fundamental, well grounded education.

Apprenticeship Course

To-day there are wanted specialized, efficient, experienced young men. With the big business development, these wants will only be augmented. How best can our young men be trained well, efficiently and speedily, that they may be of value to these businesses? Some concerns have solved the problem by the institution of the apprenticeship course, and more are coming to a recognition of its value every year. This is the keynote for the future engineer, as here are offered prearranged schedules of experience, designed to fit a man for a particular specialization. The industries find the institution an economy, and the young engineer finds it of untold benefit. It is so familiar to all that more need not be said of it.

Here we have a youngster who has chosen his vocation and can find no course leading to what he desires. What will become of him? This can readily be solved. He has but to find a practitioner who has attained eminence in his desired line and ask him frankly the best course of study and of work to pursue to reach that end. In a majority of cases the youngster will be surprised at the other's willingness and desire to be of service.

Writing Technical Articles

Now the conclusion of the apprenticeship course must, or at least should be, the point at which the future engineer returns to college for post-graduate work if he desires and needs it. This is certainly the proper time, having learned what he wants, and in what manner he shall pursue it. Being started on his work, it behooves him to get busy. He should purchase at whatever cost the best books in his profession, and study them, buy and read as many engineering books as possible, collect data, enlarge and improve his personal library, be ready to help his elders in work of any kind, join the professional societies, practise the writing of technical articles and papers, and think, think, think. It is this that will do most toward lifting the engineer out of the rank and file and placing him on his way to eminence. The rank and file learn to do what they are told to do, but he who rises does more; he studies the relation of each operation to the business interest, how that interest can best be served, and how everything can be done in the speediest and least expensive manner for that interest. This must be his obligation.

The Engineering of Business

Further, the engineer of the future must learn the engineering of business. It is well for him to devote his energies religiously to technical subjects, but that will not suffice. Each engineering project is closely related to business; of necessity it must be, else there would be no need for that project. To-day many positions that could best be filled by engineers are supplied from other professions, as law and business. This condition in the future will be less frequent but it can only become so when the engineer appreciates his deficiencies and removes them. For this purpose he must master such subjects as finance, efficiency, economics, organization and selling, and learn of their relation to his specialized work.

EDUCATING THE PUBLIC TO AN APPRECIATION OF THE ENGINEER'S VALUE TO SOCIETY

Having acquired a mastery of these subjects, it is essential that he begin to educate the public to an appreciation of his value to society. It is not enough that he describe his achievements for his technical brethren in their journals; he must tell the public, if it is capable of comprehension, the value of his work; he must draw pictures by word of mouth, on the screen or in the press, contrasting conditions before and after its accomplishment. Self-praise is certainly undesirable, but proper recognition is something quite different, and it is when he obtains this recognition, when with insistence he demands that he no longer be treated as a hired man by the financier, but rather as an associate—then and only then will he receive that share in the profits to which his investment of skill, experience, and hard work entitles him.

Again, the engineer of the future has duties to perform, aside from his professional ones. He is naturally a leader of men, and as such must assume his place in the community life, in the leading problems and questions of the time, even in politics. And, because of his position as an employer of men of all classes, upon him rests the responsibility for the welfare of these men. It is he who must carry on this big work, it is upon him that the obligation is laid.

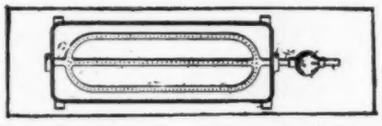
The future engineer must be a life-sized man in all ways, for he has a truly life-sized work to perform.

Patents Pertinent to Gas Industry

Gas Burner Equipped with Spherical Mixing Chamber, and Endless Tube

Patent No. 1,223,182; described in Patent Office *Gazette*, April 17, 1917, page 835. Joseph Lamb, Jersey City, N. J. Filed Apr. 25, 1916. Serial No. 93,469. (Cl. 158-116.)

This burner is provided with a spherical mixing chamber, with air slots around the inlet tube. The



burner tubes consist of an elongated round ended endless tube, with a second tube extending lengthwise across the first tube.

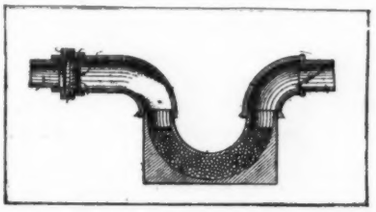
Producer Gas Obtained from Powdered Coal

Patent No. 1,223,242; described in Patent Office *Gazette*, April 17, 1917, page 852. John E. Bell, New York, N. Y. Continuation of application. Serial No. 681,880. Filed Mar. 6, 1912. This application filed July 17, 1915. Serial No. 40,461. (Cl. 48-74.)

This method for making producer gas consists in burning powdered coal in a vertically divided combustion chamber, with the divisions connected at the lower portions. A regenerator is connected to each division. The coal is supplied alternately to the two divisions, and air is passed into the division which is being supplied with fuel through one of the regenerators. The gases are passed from this division out through the other regenerator. With each change of fuel from one division to the other the air and gas flow are reversed in the two regenerators.

New Method for Purifying Gas

Patent No. 1,221,278; described in Patent Office *Gazette*, April 3, 1917, page 99. John A. Bowkus, Grand Rapids, Mich. Filed Oct. 5, 1916. Serial No. 123,864. (Cl. 183-45.)

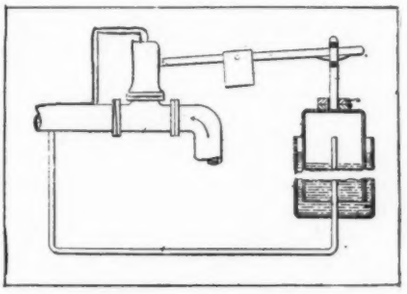


An original method of purifying gas which consists of a block equipped with a U shaped passage through it. Pipes are attached to the ends of the block and purifying material is placed in the U portion of the apparatus.

Small Gas Holder Operates Pressure Regulator

Patent No. 1,221,342; described in Patent Office *Gazette*, April 3, 1917, page 120. Charles W. McLaughlin, Buckhannon, W. Va., assignor of one-half to George I. Keener, Weston, W. Va. Filed Oct. 25, 1916. Serial No. 127,664. (Cl. 50-33.)

A controlling weight lever is attached to the valve and is also attached to the bell of a gas holder. A



small pipe connects the inside of the holder with the low pressure side of the valve. Another small pipe connects the regulator also with the low pressure side of the valve. A reduction in pressure causes the pressure to be reduced in the bell of the holder which allows the weight to press the holder down. This opens the regulator and allows more pressure to build up.

Gas Stove Provided with a Number of Baffle Plates

Patent No. 1,221,539; described in Patent Office *Gazette*, April 3, 1917, page 189. Claude R. Johnson, Neodesha, Kans. Filed Sept. 18, 1914. Serial No. 862,368. (Cl. 126-85.)

In this stove the gas burner is mounted within a casing with a baffle plate engaging the burner above the burner openings. An annular rim is mounted in the casing, with supporting members detachably engaged in the baffle plate and supported on the rim. The baffle plate is vertically adjustable on the supporting members. Additional baffle plates are arranged one above the other, with supporting members mounted on the plates, while depending supporting members adjustably engage the supporting members, so that the distance between any two of the baffle plates may be varied.

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Industrial Fuel Gas Engineering

Though it has confined itself almost exclusively to the manufactured-gas field, THE AMERICAN GAS ENGINEERING JOURNAL has realized that all gases: manufactured, blast furnace, producer, natural, coke oven, etc., are, in the broader aspect, one and the same thing, and that to render proper service to its readers—almost exclusively, as has been stated, in the manufactured-gas field—it must keep them in close touch with developments in other branches of gas engineering.

Particularly is this true in the case of the industrial fuel gas engineer. Boundless though the possibilities of the field may seem to us, THE AMERICAN GAS ENGINEERING JOURNAL is convinced that the industrial gas engineer would be jeopardizing his future were he to confine his studies exclusively to the applications of manufactured gas. From present aspects there can never be more than a salary in this one phase. In the broader phase, that of considering gas—not particularly manufactured but any commercially available gas—as his means of attaining results in heat applications, the field is boundless and the possible reward in fame or fortune beyond reckoning.

The day is not beyond vision when the use of crude fuels either in the industries or in the home will be strictly tabooed. Oil, from present indications, will not take its place. Gaseous fuel will succeed it, and he who understands thoroughly the efficient use of such fuel, especially if his own efforts have hastened the coming of that day, will be very much in demand.

Develop the Domestic Market for Coke and Secure Vastly Increased Gas Sales

In commenting on the combination gas and coal firing under the boilers of the Toledo Railways & Light Company, the *Electrical World* sees bright possibilities in the use of either the combination of gas and coal or gas alone for the generation of electric power, particularly as an expedient for pushing the output of boilers at a time of peak load, *where gas is obtainable at a cheap enough rate* to make the course practical. In this particular case the gas is obtained from by-product ovens.

As a source of cheap manufactured gas the by-product oven is without a rival. In many cases it has been found possible for gas companies to make use of it for at least a part of their supplies. There is one outstanding point of difference between the by-product coking industry and the gas industry. The first exists mainly for the purpose of producing coke. The big market for its product, already developed, is the metallurgical industries. The gas produced is a by-product and fluctuates in quantity with the market for the coke. In periods of great activity in the metallurgical field there will be immense quantities of gas produced. In dull periods the gas output decreases.

The gas industry exists to manufacture gas to meet

a constant and relatively unvarying demand. The coke and other by-products are mere incidentals. Whether there is a good market for them or not the gas must be produced.

There is an immense field for cheap gas. The *Electrical World* reveals in its editorial a large and receptive field at our very doorsteps. With an industrial gas rate as low as the Baltimore company's, for instance, general, our business in other industrial lines would leap upwards in bounds. It is quite likely indeed that King Coal as the fuel of the industries would become a very sorry looking monarch.

The by-product oven is an available means of attaining this desideratum. Its one drawback is uncertainty as to a consistent market for the vast quantities of coke it would produce. This is a drawback that can readily be eliminated. An immense market lies at the very doorsteps of our larger companies—the domestic market; the use of coke for purposes coal is now being used for in the homes and in local industries. It is a market that merely requires a certain amount of research work and development.

Eliminating Non-Essential Tasks

The service idea, it may well be said, has been the basis of the present healthy condition of the gas industry; likewise of many other industries as well. Yet "service" has not, up to this time, been brought down to an exact science. Our original invesments in this direction brought such excellent returns that we leaped, without the degree of deliberation we would apply to a departure in the manufacturing end, at each new idea. In our eagerness to serve we are undertaking tasks in which the benefit the patron derives is in nowise proportionate to the cost of rendering them. This is true to an exaggerated degree in the general retail manufacturing field with its delivery system.

We were greatly worried at first at the idea of taking a number of millions of men and putting them into what in peace times would be considered non-productive tasks. As the days pass we are arriving at a saner view.

There are for one thing, even in this nation of business men, many idlers and parasites; human beings in various stations of life—not confined by any means to the financially independent class—who subsist on the efforts of others and give nothing in return. Unfortunately it is the working type; the type that succeeds in civil life; which also is the best soldier. Otherwise the solution of the problem would be simple. We could merely take the idlers and chronic sluggards and keep the real men at work. As it is the sluggard type is an asset to us only in proportion to the degree the industrious type can assimilate it in the various military organizations.

Sound-thinking men tell us, however, that the country could supply three million men without detriment to industry by merely eliminating non-essential tasks. THE AMERICAN GAS ENGINEERING JOURNAL does not believe there is a considerable proportion of such tasks in the gas industry, but undoubtedly there are some. We are not perfect.

We should therefore seek at once to locate and eliminate them. The men freed might not in themselves be military assets, but by systems of transfer they could be used to replace men in other tasks who are.

Needless Illumination

The matter of flood lighting merely to secure beautiful effects and of electric signs, etc., as a great source of waste of coal has come in for considerable attention since this country engaged in the World War, and even electric central stations begin to feel the pinch in the matter of fuel. Still we notice no particular curtailment in this branch of the electric companies' business, and only within the past few weeks no less personage than the director of the U. S. Bureau of Mines has come out strongly against it.

The surprising thing is that we had to await the pinch of wartime conditions to awaken to this tremendous and utterly needless form of waste of a natural resource, the lack of which future generations will lament bitterly.

Few communities that style themselves cities are free from the electric advertising sign, some representing thousands of bulbs and consuming large amounts of power. What useful purpose these signs serve, or have served, other than furnishing a novelty to some out-of-town visitor would be difficult to establish.

It is contended that advertising has materially raised the standard of American life; that the advent of advertising has hastened the country's development to an extent beyond measure. These contentions are conceded. But the electric sign has not necessarily been indispensable to this end.

The principal reason why popular advertising has been so effective in this country is that so high a proportion of its population is able to read and does read a huge volume of printed matter. Because of this, it is doubtful indeed if the doctrine of the "best breakfast food" would have failed to reach as many as it has reached even if the electric sign had never been heard of.

A more flagrant waste of a vital natural resource, however, either in peace or in war, than is represented in the electric advertising sign, would be difficult to conceive of, unless we place alongside of it perhaps the flood-lighting of "the tops of apartment buildings merely for purposes of beautifying them." It is possible that the war will have an influence in minimizing such forms of waste and it is sincerely to be hoped that when we return to peace-time conditions we will never have a recurrence on so large a scale of such reckless forms of publicity.

Formulas for Determining Accurately Heat Carried Off by Flue Gases

The Following Formulas by Which Heat Loss in Flue Gas Calculations Can Readily be Made, Deduced by E. A. Uehling, are Published in *Stevens Indicator* for April

The formulas are based on carbon as a unit (1 lb.); useless refinement has been avoided, and fractions have not been carried beyond the second decimal place. The sulphur contained in the fuel has been ignored as such because the SO_2 resulting from its combustion is largely if not altogether measured in with the CO_2 and its consideration would lead to useless complication.

Formula for Calculating the Heat Carried Off by the Flue Gases—Notation

Ac = Weight of air required to burn one pound of carbon.

Ah = Weight of air required to burn one pound of hydrogen.

At = Weight of air supplied in excess of that required to burn a weight of fuel containing one pound of carbon.

Ae = Total weight of air supplied in burning a weight of fuel containing one pound of carbon.

Nh = Weight of nitrogen contained in the weight of air required to burn one pound of hydrogen.

Gd = Weight of dry gas contained in the products of combustion resulting from burning a weight of fuel containing one pound of carbon.

O = Weight of oxygen per pound of carbon in the fuel.

Ht = Weight of hydrogen per pound of carbon in the fuel.

Ha = Ht $-\frac{O}{8}$ = Weight of available hydrogen per pound of carbon in the fuel.

Av = Weight of water vapor in air used to burn one pound of carbon.

Fm = Weight of moisture in fuel per pound of carbon.

Fhy = O $+\frac{O}{8}$ = Weight of water of hydration combined water in fuel per pound of carbon.

W = Fm + Fhy.

P = Per cent of CO_2 in the flue gas.

Pc = Per cent of CO in the flue gas.

Pe = Per cent of excess of air in the flue gas.

Po = Per cent of excess of oxygen in the flue gas.

T = Temperature of flue gas on leaving the boiler.

t = Temperature of air supplied for cumbustion.

S = .24 = Specific heat of dry flue gas.

Sw = .48 = Specific heat of water vapor in flue gas.

L = B.t.u. carried off by the flue gas when burning carbon with the theoretical weight of dry air.

Ld = B.t.u. carried off by the dry flue gas per pound of carbon burned.

Lh = B.t.u. carried off by the H_2O produced in burning the hydrogen.

Lc = B.t.u. carried off as fuel by the CO contained in the flue gas.

Lv = B.t.u. carried off in the flue gas due to water vapor in the air.

Lm = B.t.u. absorbed and carried off due to moisture in the fuel.

Lhy = B.t.u. absorbed and carried off due to water of hydration in fuel.

Pure air contains	By weight	By volume
Oxygen	23	21
Nitrogen	77	79

One cu. ft. of air at 62 deg. Fahr. weighs .0761 lb.

One cu. ft. of nitrogen at 62 deg. Fahr. weighs .0742 lb.

Complete Combustion of Carbon with Theoretical Amount of Air

One pound of carbon requires for complete combustion 11.6 lb. of air which at 62 deg. Fahr. measures $\frac{11.6}{.0761} = 152$ cu. ft. hence Ac = 11.6 lb. by weight and 152 cu. ft. by volume, therefore the products of complete combustion of one pound of carbon with the theoretically required air will weigh Ac + 1 = 12.6 lb. and the loss of heat up the chimney will be

$$L = 12.6 \times (T\text{-}t)\ S \qquad (1)$$

Substituting for S its numerical value we have

$$L = 3\ (T\text{-}t) \qquad (2)$$

Complete Combustion with Excess Air

Since, according to Avogadro's law, all molecules of gas occupy the same volume, it follows that $CO_2 = O_2$ and that 21 per cent of CO_2 must be contained in the products of combustion because every molecule of O in the air consumed forms a molecule of CO_2, hence when carbon is burned with the theoretical volume of air required for complete combustion

$$P = \frac{Ac \times 21}{Ac} = \frac{152 \times 21}{152} = \frac{11.6 \times 21}{11.6} = \frac{243.6}{11.6}$$

When carbon is burned with an excess of air

$$Ae = \frac{Ae}{0.0761} \text{ by volume}$$

$$P = \frac{Ac \times 21}{Ac + Ae} = \frac{152 \times 21}{152 + \text{vol. of excess air}} = \frac{152 \times 21}{152 + \frac{Ae}{0.0761}}$$

from which find that

$$Ae = \frac{Ac \times 21}{P} - Ac \qquad (3)$$

The weight of the products of combustion per pound of carbon is 1 + At, hence

$$L = (1 + At)\ S \times (T\text{-}t) \qquad (4)$$

At = Ac + Ae substituting the value of Ae from equation (3) we get

$$At = \frac{Ac \times 21}{P} = \frac{243.6}{P}$$

Substituting this value and the value of S into equation (4) and reducing we have

$$L = \left(.24 + \frac{58.46}{P}\right) \times (T\text{-}t) \qquad (5)$$

Complete Combustion with the Theoretical Weight of Air when the Fuel Contains Hydrogen

In burning one pound of hydrogen 8 lb. of oxygen are required resulting in 9 lb. of water vapor (H_2O). Since air contains 23 per cent of oxygen and 77 per cent of nitrogen

$Ah = \frac{8}{0.23} = 34.8$ lb. of air must be supplied, containing $Nh = 34.8 \times 0.77 = 26.8$ lb. of nitrogen.

By volume

$$Ah = \frac{34.8}{0.076} = 457 \text{ cu. ft.}$$

and

$$Nh = 457 \times 79 = 361 \text{ cu. ft.}$$

For the heat carried away by the dry gas with theoretical air supply and complete combustion we have

$$Ld = (1 + Ac + Nh \times Ha)\, S \times (T - t) \quad (6)$$

Substituting the value of S and the weight values of Ac and Nh and reducing we get

$$Ld = (3 + 6.4\ Ha) \times (T - t) \quad (7)$$

and for the heat carried away by the H_2O from the hydrogen we have

$$Lh = 9\ Ha \times Sw \times (T - t) = 4.3\ Ha \times (T - t) \quad (8)$$

When the fuel containing hydrogen is burned with an excess of air we have

$$P = \frac{Ac \times 21}{Ac + Nh \times Ha + Ae}$$ from which we get

$$Ae = \frac{Ac \times 21}{P} - (Ac + Nh \times Ha) \quad (9)$$

The heat carried off by the dry gases is

$$Ld = (1 + Ac + Nh \times Ha + Ae)\, S \times (T - t) \quad (10)$$

Substituting the value of Ae from equation (9) and reducing we get

$$Ld = \left(1 + \frac{Ac \times 21}{P}\right) S \times (T - t) \quad (11)$$

Substituting the values of Ac and S, we get

$$Ld = \left(.24 + \frac{58.46}{P}\right) \times (T - t) \quad (12)$$

Loss Due to CO in Products of Combustion

When the percentage of CO (Pc) is known, the heat loss due to its presence (Lc) is easily determined. The weight of carbon in a molecule of CO is the same as in a molecule of CO_2 and it follows from Avogadro's law that the weight of carbon burned to CO is to that burned to CO_2 as the per cent of CO is to the per cent of CO_2 contained in the products of combustion.

Thus letting X = the weight of carbon burned to CO we have $\frac{X}{1 - X} = \frac{Pc}{P}$ from which we get $X = \frac{Pc}{P + Pc}$ = carbon burned to CO per unit of carbon contained in the fuel. Since CO burned to CO_2 per unit of carbon develops 10,150 B.t.u. we have

$$Lc = 10{,}150\, \frac{Pc}{P + Pc} \quad (12)$$

Loss Due to Water Vapor in the Air

Atmospheric moisture exerts a chilling effect on the fire because of its high specific heat and because at least part of it will decompose. But since under normal conditions the hydrogen which is set free by decomposition will reunite with oxygen in the combustion chamber and will evolve as much heat there as was absorbed in the fuel bed in setting it free, there results no heat loss due to this double reaction. It will be necessary, therefore, to consider only the sensible heat carried off by moisture contained in the air, hence, we have

$$Lv = Av\ (Ac + Ah \times Ha + Ae)\ Sw \times (T - t)$$

Substituting the value of Ae from equation (9), we have

$$Lv = Av \left(\frac{Ac \times 21 + 8\ Ha}{P}\right) Sw \times (T - t) \quad (13)$$

giving Ac and S their numerical values and reducing, we have

$$Lv = Av \times \left(\frac{117}{P} + 3.84\ Ha\right) \times (T - t) \quad (14)$$

Loss Due to Water in Fuel

The water in fuel Fm exists as moisture and water of hydration which must be first raised to 212 deg. as such, it then evaporates and passes off with and at the temperature of the products of combustion, therefore,

$$Lw = (Fm + Fhy) \times (212 - t + 970 + (T - 212)\ Sw) \quad (15)$$

Substituting the value of Sw and reducing

$$Lw = (Fm + Fhy) \times (0.48\ T - t + 1080) \quad (16)$$

Heat in B.t.u. carried off by the products of combustion due to H_2O contained in the fuel.

The theoretical maximum per cent of CO_2 obtainable from fuel containing hydrogen is

$$Pm = \frac{Ac \times 21}{Ac + Ah \times Ha} = \frac{152 \times 21}{152 + 361\ Ha} = \frac{21}{1 + 2.38\ Ha} \quad (17)$$

The per cent excess air in the products of combustion is readily determined if we know the per cent of CO_2 and the hydrogen contents in the fuel, then

$$Pe = \frac{Ae \times 100}{Ac + Ah \times Ha} \quad (18)$$

By volume from equation (9) have

$$Ae = \frac{152 \times 21}{P} - (152 + 361\ Ha) \quad (19)$$

$$Ac = 152 \text{ and } Ah = 457$$

Substituting these values in equation (18) and reducing we get

$$Pe = \frac{2100}{P\ (1 + 3)\ Ha} - \frac{100 + 238\ Ha}{1 + 3\ Ha} \quad (20)$$

The per cent of oxygen in the dry gas equals the per cent in the excess air divided by the total volume of dry gas, hence

$$Po = \frac{Ae \times 21}{Ac + Nh \times Ha + Ae} \quad (21)$$

Substituting the volumeative value of Ae, Ac and Nh this equation reduces to

$$Po = 21 - (1 + 2.38\ Ha)\ P \quad (22)$$

Recapitulation

Heat carried away by the Dry Gases.

$$Ld = \left(0.24 + \frac{58.46}{P}\right) \times (T - t) \quad (A)$$

Heat Carried Away Throhgh Incomplete Combustion

$$Lc = \frac{10150\ Pc}{P + Pc}$$ + other combustibles difficult to determine, generally negligible, when proper combustion conditions obtain. (B)

Heat Carried Off by Water Vapor in Air

$$Lv = Av \left(\frac{117}{P} + 3.8\ Ha\right) \times (T - t) \quad (C)$$

Heat Carried Away by the H_2O from the Combustion of Hydrogen

$$Lh = 4.32\ Ha \times (T - t) \quad (D)$$

Heat Carried Away by the Moisture and Water of Hydrogen in the Fuel

$$Lw = (Fm + Fhy) \times (0.48\ T + 1080 - t) \quad (E)$$

The Theoretical Maximum CO_2 Obtainable from Fuel Containing Hydrogen

$$Pm = \frac{21}{1 + 2.38\ Ha} \quad (F)$$

PER CENT EXCESS AIR SUPPLIED

$$Pe = \frac{2100}{P\,(1 + 3\,Ha)} - \frac{100 + 238\,Ha}{1 + 3\,Ha} \qquad (G)$$

PER CENT OF OXYGEN IN GAS

$$Po = 21 - (1 + 2.38\,Ha)\,P \qquad (H)$$

The importance of CO_2 in the flue gas becomes apparent by a glance at these formulas. Since it appears as a divisor in three of the five heat loss equations, it is obvious that economical boiler operation can be attained only with a high per cent of CO_2 in the escaping gases. Formula (A) represents the bulk of the heat carried to waste up the chimney. This loss depends on the content of CO_2 and the temperature of the escaping gas, and since other things remaining equal, the stack temperature falls as the CO_2 rises, it becomes doubly advisable to strive for the highest per cent of CO_2 compatible with complete combustion.

NEED OF A CO_2 INDICATOR AT BOILER POINT

The bulk of the loss due to incomplete combustion is given by formula (B). In extreme cases there may be additional loss due to unconsumed hydrogen, hydrocarbons and carbon in the form of soot, but the loss due to these elements is rarely appreciable except in the presence of dense smoke. While it would seem obvious that the danger of loss through incomplete combustion must increase with the per cent of CO_2, *i.e.*, the decrease of excess air, it is none the less a fact that complete combustion depends in a much larger degree on the construction of the furnace, and proper stoking than on a large excess of air.

There exists no relation between the CO and CO_2 content in flue gas so long as there is four per cent or more of free oxygen present. The maximum per cent of CO_2 that should be carried at any given plant depends (a) on the kind of fuel used, (b) on the construction of the furnace, and (c) on the skill and conscientious attention of the fireman. (a) is a commercial proposition, (b) is an engineering problem, and (c) is a question of faithful performance of duty.

But no fireman, however faithful and conscientious he may be, can do his duty intelligently and efficiently without scientific aids to guide him. He cannot be expected to maintain an even high per cent of CO_2 without a continuous CO_2 indicator at the boiler front to guide him, any more than he could be expected to keep an even steam pressure without a steam gauge to show him where he is at.

In addition he must be provided with means for analyzing his draft, and if his boiler is equipped with a steam flow indicator so much the better. With a furnace adapted to the kind of fuel used, and equipped as above, any good fireman can maintain a maximum per cent of CO_2 with a minimum of CO and obtain the highest boiler efficiency, but not without. With a high per cent of CO_2 and low humidity in the air the heat loss represented by formula (C) is negligible, but with these conditions reversed, or where oil fuel is atomized by steam it may become quite appreciable.

The heat loss due to formulas (D) and (E) is independent of CO_2 in the escaping gases. Compared with the heat loss due to dry gas (formula A) the losses due to the H_2O from the combustion of the available hydrogen in the fuel (formula D) and the steam generated from the water in the fuel (formula E), are comparatively small with dry fuel of low hydrogen content, but increase in importance with the hydrogen and water content of the fuel. These losses are independent of the per cent of CO_2 and hence beyond the control of the fireman.

IMPORTANCE OF CONTINUOUS TEMPERATURE RECORDS

(T-t) appearing as a multiplier of the heat loss in every formula except (B) the importance of continuous temperature records of boiler house, and the gases at the point where they leave the boiler becomes obvious. But since this temperature may become very materially reduced by cold air creeping in through leaks and crevices, and pores of the brickwork (air infiltration) its record is of no value without a simultaneous record of ten per cent of CO_2. The temperature at which the gases escape from any given boiler depends (a) on the cleanliness of the heating surface, inside and outside, (b) the tightness of the setting, and (c) the rate of driving. The fireman has no direct control over (a) and (b), and since he must regulate (c) according to the steam gauge the temperature of the escaping gases cannot serve as a guide to economic firing. The per cent of CO_2 on the other hand depends upon the relation of strength of draft to thickness and evenness of fire, both of which being under direct control of the fireman, it is a true index and therefore a reliable guide to him, and its continuous indication is necessary for the intelligent and efficient operation of the boilers.

Formula (F) gives the maximum per cent of CO_2 that can result from the combustion of any given fuel. The lower the ratio of carbon to hydrogen the lower the per cent of CO_2 that can be carried without danger of incomplete combustion due to deficiency of air supplied. The per cent excess air is readily determined by formula (G). It is more important, however, to know the per cent of oxygen in the flue gas; this is easily determined by the very simple formula (H). Next to CO_2 oxygen is the most important constituent of the flue gas to know. Some combustion experts (notably William Kent) advocate the continuous recording of O in preference to CO_2, and because from four to six per cent of flue oxygen should be present in the products of combustion irrespective of the carbon hydrogen ratio in the fuel, it would appear that oxygen might be the better guide to secure efficient combustion. But since the per cent of CO_2 must be known in order to determine the heat loss, and since the CO_2 can be more readily and more accurately determined than the oxygen, because it is absorbed with more certainty, and because of its greater volume (about three times as great in good work) any errors in analysis are minimized, and since when the analysis of the fuel is known the most probable economical per cent of CO_2 can always be predetermined, by substituting the desired value of Po in formula (H) and solving for P, so that the advantages in favor of CO_2 greatly outweigh those in favor of O. Such predetermination of the probable most economical per cent of CO_2 can only be tentative, however, since the construction of the furnace and kind and quality of the fuel used may not permit complete combustion with the per cent of free oxygen assumed to be sufficient. If, however, an appreciable per cent of CO appears in conjunction with five to seven per cent of O there is something radically wrong, which it will pay to search out and remedy.

CONDITION OF GARDEN ON WHICH AMMONIUM SULPHATE WAS USED

The Gas Industry as a Producer of Fertilizing Material

England Paid Dearly for Saving Small Sums Through Buying German Fertilizer and Neglecting Home Production of Ammonium Sulphate

By NORTON H. HUMPHRYS

The war brings home to us many important lessons. We have been accustomed to think that our individual property concerns no one but ourselves, and that buying, selling, hoarding and spending are personal matters only.

We are now paying dearly for this mistake. We have learned that there is also a National and a Patriotic side to all these things, insomuch as they tend to the advantage or otherwise of our country, or in a wider sense, of humanity in general.

On these lines buying and selling in the best market is not necessarily the soundest policy. Amongst the elaborate preliminary organizations that were made by those whom we have the strongest possible reasons for describing as our enemies a dumping policy was a prominent feature.

It is obvious that a small individual profit cannot compensate for money sent into an enemy country if it incidentally assists in paying for the armaments that are used against us. It has shown us that transport facilities, even from the next county, are not invulnerable, that ocean transit is attended with many uncertainties, and that we should be prepared, as far as possible, for the home production of absolute necessaries, and certainly not entirely dependent on foreign supplies.

Coming nearer home, we have a prominent illustration of the enormous possibilities inherent in the gas industry, either in peace or war; and we must see that there is no loss or waste either by the use of inefficient producing, extracting, storing or manufacturing plant, and especially by the export of material that is needed at home.

Proving Value of Ammonium Sulphate

These reflections are suggested by some experiences related by J. Mogford at a meeting of the Wales District Institution of Gas Engineers, which go to prove that he is one of that useful class (now especially needed) who not only preach but practice.

Early last year all local authorities throughout the country were requested by the Government to secure the cultivation of all waste land in their district, and to facilitate the letting of small allotments for that purpose.

Mr. Mogford, not satisfied with only preaching the benefits of ammonium sulphate, personally obtained a plot for the purpose of practical demonstration and for encouraging its use, thus helping his country and his company at the same time by increasing production and creating a home market.

The importance of a proper use of artificial fertilizers is receiving attention from the Board of Agriculture, who are issuing leaflets and otherwise encouraging information on the subject, so the public is at present in a mood for giving favorable reception to enterprise in this direction.

CONTRASTING CONDITIONS IN NEIGHBORING GARDEN PLANTED WITHOUT THIS ADVANTAGE

The land in question was rough pasture that had not been cultivated or manured for many years. Stable manure was scarce, as were the best strains of potato seed, and planting could not be effected until late in May, quite two months behind normal time.

But in September Mr. Mogford lifted a crop of potatoes that excited both the admiration and the envy of his neighbors, as many of the adjoining crops were a failure. The difference is illustrated by the enclosed photographs, which show Mr. Mogford's plot, as compared with one on which no sulphate was used. Much interest was the natural result, and pamphlets as provided by the sulphate of ammonia committee were distributed to all inquirers.

Sulphate Not an All-Around Manure

Last December the extension of allotments was further considered and the local committee requested Mr. Mogford to accept the office of fertilizer expert and adviser in connection with the opening up of 350 parcels each of 10 perches area. Supplies of lime, superphosphate, bone compound and ammonium sulphate were stored at the gas works and sold out in quantities suited to requirements.

An expert gardener was also retained, pamphlets containing full instructions were provided, and each holder of one plot was advised to apply 1¼ hundredweight of lime when opening up the land and a mixture of 28 lb. superphosphate and 10 lb. sulphate, part to be applied when planting and the remainder as a top dressing.

As the result, Mr. Mogford strongly recommends every gas manager to obtain a seat on the local allotment committee, so as to be in a position to advocate the use of sulphate, assist the production of home-grown food, and help to build up a demand for the only nitrogenous fertilizer at present on the market, and in any case the only home product in that line.

He mentioned that sulphate was not to be regarded as an all-round manure. Lime was an absolute necessity in the absence of potash salts, and all available weeds, wood, branches, etc., should be burned and the ashes spread and dug in.

Test as to Need for Lime

Personally this subject is attractive at any time, because I have been accustomed to grow all fruit and vegetables for household requirements, and have found that the advantages of sulphate can be more convincingly set forth in the course of a stroll round the garden on a fine summer day, when all is in full bloom, than by any amount of leaflets and other literature.

It must not be forgotten that sulphate is only a nitrogenous manure, and that lime, potash, phosphorus, etc., must also be present in the soil, in sufficient quantity, if satisfactory crops are to be obtained, that many soils, if not deficient in lime, in the first place, soon become so by depletion, and that all mineral matters removed by the crops must be replaced.

A simple lime test can be made by selecting a fair average sample of the soil, drying and coarsely powdering, and adding a good spoonful to half pint diluted hydrochloride acid (1:4).

If stirring is not attended with an immediate and fairly brisk effervescence a dressing of lime is needed, and should be well dug into the soil before the next planting.

Shallow digging is frequently a source of poor crops, particularly in the case of roots, and the labor spent in digging two or three spits deep will yield quite a remarkable return.

Diluted Liquor Can Be Used in Garden to Good Advantage

Harking back to waste of ammonia. There are works too small to run a sulphate plant with profit, so situated that supplies of acid are not obtainable, or at such a distance from the nearest chemical works that neither liquor or acid will pay for carriage.

It is getting quite a common practice here to collect liquor over a radius of 20 miles or so by means of road motor tanks carrying 4 to 5 tons, or a few neighboring small works combine to erect a plant at the most central spot.

But even under the most adverse conditions it need not be wasted. It cannot be applied direct to cultivated land without being diluted to 1 deg. Tw. or less, but in that form I have known it to be applied to grass land early in the year with satisfactory results.

Some time ago I persuaded a neighboring farmer to treat a large field in this manner, using an ordinary sprinkler cart, and in the ensuing summer the difference between that and the next field was quite prominent. The crop was a more brilliant green color and heavier per acre, but my friend would not give me comparative figures, which he would not have failed to do if there had been no appreciable benefit.

A few experiments on the line followed by Mr. Mogford will prove that the diluted liquor can be used in the garden with advantage, but the composition of the soil, the climatic conditions, etc., vary so widely that anything in the way of general directions or quantities to be applied per acre require to be handled with caution, and at the best fall short of a few intelligent local experiments.

Making Water Gas in Vertical Retorts

Considerable discussion is going on in England in regard to using vertical retorts for the manufacture of water gas. The following method of procedure recommended by Dr. R. Geipert is published in the *Gas World:*

A vertical retort, capable of dealing with 1.2 tons of coal in twelve hours, is heated up in the usual way and filled, not with coal, but with coke in lumps or nuts. The coke will be glowing in six hours. Then steam through a nozzle of 0.14 in. in diameter and under a pressure of 28 lb. for eighteen hours. This will represent 539 lb. of steam. Rake out the spent coke and ashes. The water gas produced will be 17,093 cu. ft. After using a vertical retort in this way, let the next charge be of coal, so as to get graphite to fill up any chinks. One or two retorts out of a bench or battery, treated in this way, may give as much water gas as is required.

In making water gas by steaming in the usual way trouble arises in the final stages through the dense layer of coke becoming covered with a protective coating of ash.

Assistant Develops Four Times the Power of 5 Hp. Gas Engine

To the many debts we owe the internal combustion engine, there is likely to be added, according to the military experts, the debt of its winning the war for us. The science of aviation has kept ahead of the engine that has brought the flying machine to its present stage of usefulness.

The laws of the air in relation to flight were investigated exhaustively by the late Dr. Samuel Pierpont Langley, then director of the Allegheny Observatory. Dr. Langley's experiments were conducted chiefly by means of an "aerodrome," a horizontal structure mounted on a vertical axis. At one end of the structure various pieces of apparatus were mounted in turn, to be driven against still air, so as to record the various performances of planes and propellers.

To drive the aerodrome or turntable there was provided a 5-hp. gas engine of standard make. One day it became desirable to resume the outdoor experiments, and the mechanician was instructed to start the gas engine.

After a time he succeeded, and the turntable was driven at the magnificent speed of six revolutions per minute.

That was not enough, and while the authorities consulted, a young assistant, still in his teens and with the surplus energy of the period, seized the handle that was provided for bringing the turntable to any desired position for adjustment purposes, and drove the turntable thirteen revolutions per minute, developing four times the power of the 5-hp. engine, if the resistance increased as the square of the speed. An expert was then summoned, who spent half a day grinding the valves. Then the engine ran half a day and stalled. The expert wanted to spend another half-day regrinding the valves, but Dr. Langley called them all off and adopted a rusty old harvester engine that happened to be in the neighborhood.

That was the status of the internal combustion engine at the time the laws of flight were being developed. About eighteen years afterwards the Wright brothers flew. They acknowledged their debt to Langley for the laws governing flight, the world had given them the engine and they had invented their stabilizing and other devices which enabled one to fly without coming to grief. Gustav Lilienthal had had many successful "glides" without a motor before he met his death in one sixteen years before the Wright brothers flew.—*Metallurgical and Chemical Engineering.*

News of the Gas Industry

Wichita Company Enters Into New Gas Contract

A contract has been entered into by which the Wichita Gas Company will extend a pipe line from its station at Big Heart, Okla., to the Hominy lease, owned jointly by the Osage Hominy & Sinclair Gulf Corporation.

The Wichita Gas Company will pay 3½ cents per 1,000 cu. ft. for the gas, and the 8-in. line is expected to carry sufficient gas to add about $600 to the Osage Hominy Company's daily income.

Pana, Ill., Plant Sold

The plant and all of the business interests of the Peoples Gas Company of Pana, Ill., were sold recently to the Central Illinois Public Service Company. The purchase price as named in the deal is $55,000. The Public Service Company took over all of the holdings and property at once. Thomas J. Vidler is president and manager; George A. Wittmann, vice-president, and F. A. Cutler, secretary-treasurer. The plant was constructed in this city in 1912 and the service has been good at all times and the business well managed.

Hartford Company Reports Progress With Manchester Extension

The Hartford City Gas Light Company is making good progress on the laying of the gas mains which will be used in carrying the supply of gas from Hartford to Manchester consumers. The start was made in Manchester, at the east end of the Rogers' property on Hartford Road, or at a point about opposite the entrance to the present gas house owned by Cheney Brothers, whose business in this line the Hartford company is to take over. They follow the highway, a trench digger being used and little trouble seems to be had in digging a narrow trench about forty inches deep. The trench which is opened is too narrow for men to work in and connect the pipes, so the pipes are welded together above ground and then lowered into the trench with hand block and falls. A stretch of pipe line over 500 ft. can be lowered at one time. The trench has already been opened as far as McKee Street and pipe has already been distributed along the road much further than that. It will take very little time to cover in the trench and this is being done about as fast as the pipes are lowered. It appears from the progress being made that the connection will be made early in the fall.

Consumers Gas Company Asks Raise in Rates

The Consumers Gas Company asked the corporation commission at Oklahoma City, Okla., recently for permission to increase its rates on gas furnished to the Vinita Gas Company from 10 cents, the present rate, to 15 cents per 1,000 cu. ft. No date for hearing on the application was set.

Coatesville Company Moves to New Offices

The Coatesville Division of the Philadelphia Suburban Gas & Electric Company have moved to their new office at Third Avenue and Main Street, which has recently been completed.

One of the opening features was a gas range demonstration, and also an intensive advertising campaign in co-operation with the national preserving and canning movement.

We understand through information from N. B. Bertolette, division manager, that the residents of Coatesville are greatly impressed with the gas company's new office, and also with the fact that a prominent corner of the city that was heretofore dark and gloomy is now brilliantly lighted.

Ohio Companies Discontinue Gas at Industrial Rates

Letters were sent out by the Columbus Gas & Fuel Company and the Federal Gas & Fuel Company notifying industrial consumers that after July 31 they will discontinue furnishing gas at industrial rates. The Ohio Fuel Supply Company has taken similar action with reference to industrial consumers, effective soon. The Ohio Fuel Company sells gas at wholesale to the two local distributors. It has given these companies an extra month to notify their industrial consumers that the industrial rates will be terminated. These rates have been determined by a sliding scale based on consumption and are considerably below the domestic rates.

Letters of the local companies point out that the contract between them and the Ohio fuel for gas to be sold at industrial rates expired April 1 and has been continued since then by mutual consent. Gas companies regard the domestic consumers as in a preferred class and desire to conserve supplies for them.

First Hearing on Indiana Heat Unit Question

Happenings in the Indiana Gas Association case have been rapid within the past few days in Indiana. At the first hearing of the big case, in which the Indiana Gas Association seeks authority from the Public Service Commission of Indiana to lower the calorific standard of artificial gas from 600 B.t.u. to 550 B.t.u., two important phases of the situation were developed. One was the raising of the question of the jurisdiction of the Indiana commission, by opponents of the heat-unit lowering proposal, and the other was a sudden petition, filed by the gas companies with the commission, asking for permission for the members of the gas association to collect a temporary surcharge on each gas bill, monthly, that is sent to gas consumers. The association's petition asked for an order by the commission, "authorizing and directing the gas utilities of the state to add temporarily a service charge of 50 cents a meter a month, or a surcharge which we believe should at this time be not in excess of approximately 25 per cent, providing the same be an amount that fairly reimburses the various companies for the excess costs now being paid for materials, same to be continued only during such period as the existing abnormal price conditions prevail; however, should prices exceed those of to-day to any considerable extent, further and additional relief will have to be asked."

The Indiana Electric Light Association has asked the commission for authority to promulgate and collect a surcharge of 30 per cent, during the war price era, based chiefly on the increased cost of coal and other supplies and materials, entering into the cost of producing electricity.

The following cities will be affected by the petition for a surcharge:

Aurora, Bluffton, Bedford, Bloomington, Crawfordsville, Columbus, Connersville, Decatur, East Chicago, Elkhart, Evansville, Franklin, Ft. Wayne, Frankfort, Goshen, Greencastle, Hammond, Huntington, Indiana Harbor, Jeffersonville, Lebanon, Logansport, La Porte, Michigan City, Mishawaka, New Albany, Ossian, Peru, Princeton, Plymouth, Rich Valley, Rochester, South Bend, Terre Haute, Valparaiso, Warsaw, Whiting, Washington and Lawrenceburg.

The following companies have joined in the petition:

Consumers Gas Company, Citizens Gas & Fuel Company, Columbus Gas Company, Central Indiana Lighting Company, Evansville Public Corporation Company, Elkhart Gas & Fuel Company, Franklin Water, Light & Power Company, Goshen Gas Company, Greencastle Gas Company, Huntington Light & Fuel Company, Hydro Electric Light & Power Company, Indiana Public Service Company, Interstate Public Service Company, Laporte Gas Company, Northern Indiana Gas & Electric Company, United Gas & Electric Company, Rochester Gas & Fuel Company, Valparaiso Lighting Company, Warsaw Gas Company, Washington Gas Company and Lawrenceburg Gas Company.

Gas Companies of 43 States Push Canning and Preserving Campaign

The following list presents the 201 cities in 43 States of the Union that are pushing the N. C. G. A. Nation-wide Canning and Preserving Campaign. These 201 cities represent 256 gas offices. They accounted for the display of 6,000 July posters in the windows and on the wagons of grocers, produce dealers, department stores and gas companies. They distributed 400,000 copies of the July folder of recipes prepared by Mrs. Ida C. Bailey Allen and they gave to women who visited the gas offices and attended lectures or cooking classes, 90,000 gummed label book-

Alabama—Montgomery.
Arizona—Phoenix.
Arkansas—Helena.
California—Hemet, San Francisco, Watsonville, Santa Cruz, Hollister, Gilroy.
Canada—Vancouver, B. C.
Colorado—Canon City, Denver, Pueblo, Greeley, Colorado Springs.
Connecticut—New London, Danbury, Derby, New Haven, Thompsonville, Waterbury.
Delaware—Wilmington.
District of Columbia—Washington.
Florida—Tampa.
Georgia—Atlanta.
Illinois—Kewanee, Freeport, Galena, Lincoln, Rockford, Dixon, Bloomington.
Indiana—Terre Haute, Elkhart, Seymour, Rochester, Warsaw, Indianapolis.
Iowa—Burlington, Waterloo, Des Moines, Fort Dodge, Iowa City, Washington, Ottumwa, Davenport, Fairfield, Keokuk, Charles City, Red Oak, Shenendoah, Decorah.
Kansas—Arkansas City, Salina.
Kentucky — Richmond, Shelbyville.
Maine—Bangor.
Maryland — Baltimore, Hagerstown.
Massachusetts — Adams, Arlington, Boston, Brockton, Nantucket, Clinton, Chelsea, Fall River, Gardner, Gloucester, Greenfield, Haverhill, Leominster, Lowell, Milford, North Adams, Northampton, East Braintree, Salem, Spencer, Boston, Revere, Williamstown, Palmer, Hyde Park, New Bedford.
Michigan—Grand Rapids, Charlotte, Ann Arbor, Detroit, Benton Harbor, Big Rapids, Three Rivers, Ishpeming, Marquette.
Minnesota—St. Paul, Mankata.
Mississippi — Hattiesburg, Jackson, Meridian.
Missouri—Sedalia, Independence, St. Louis, Kirksville, Chillicothe.
Montana—Billings.
Nebraska — Fairbury, Fremont, Beatrice, Grand Island, Hastings, Lincoln, Plattsmouth, York.
New Hampshire — Portsmouth, Franklin.
New Jersey—Millville, Glassboro, Newark, Atlantic Highlands, Long Branch, Rahway, Red Bank, Flemington.
New York — Brooklyn, Elmira, Auburn, Kingston, Schenectady, Tonawanda, Ogdensburg, Rochester, Utica, Mt. Vernon, Poughkeepsie, Newburgh, Amsterdam, Catskill, Lockport, Long Island City, Malone, Albany, Saratoga Springs.
North Carolina—Asheville, Fayetteville, Rocky Mount, Charlotte.
North Dakota—Fargo.
Oklahoma—Bartlesville.
Ohio—Alliance, Ashtabula, Hamilton.
Oregon — Pendleton, Portland, Astoria.
Pennsylvania—Allentown, Reading, Greenville, Lebanon, Hazleton, Kingston, Chester, Coatesville, Jenkintown, Pottstown, Philadelphia, Wilkes-Barre, York, Hanover, Renovo, Lancaster, Huntingdon, Lewistown, Williamsport.
Rhode Island—Providence, Pawtucket, Woonsocket.
South Carolina—Rock Hill.
South Dakota—Huron, Mitchell.
Tennessee—Bristol, Chattanooga, Knoxville, Nashville.
Utah—Ogden.
Vermont — Burlington, Springfield, Brattleboro.
Washington—Spokane, Olympia, Bellingham.
West Virginia—Bluefield.
Wisconsin—Portage, Waukesha, LaCrosse, Chippewa Falls, Superior, Milwaukee, Watertown, Madison, Eau Claire.

The campaign is gathering momentum every day. Its benefits to both housewives and gas companies are too numerous to be ignored. The supply of June material prepared by the Association was exhausted long before the total orders and re-orders had been filled. Even the extra allowance made in printing the July folders and posters did not suffice to satisfy the increasing demand. Safe-

ty and the assurance of receiving an adequate supply lie in placing now a liberal order for each of the remaining months of the campaign—August, September, October and November.

The August and September posters by Carter House are even more attractive than were the first two of this unusual series. The colored covers of the August and September folders are interesting additions to the gallery of types of women who are joining President Wilson's army of those who serve the nation!

Send the National Commercial Gas Association headquarters your orders for materials and report on your special activities and on the results you are obtaining.

Canadian Convention to be Held at Same Time as Canadian National Exposition

Gas Men Will Have Opportunity to See Proofs of Canada's Progress During Past 50 Years

The time for the Canadian Gas Association Convention having been chosen for August 29 and 30, the gas men attending may be assured of one of the livest and entertaining meetings, due to confederation with the Canadian National Exhibition, which is being held at the same time; the dates being August 25 to September 10.

The tentative program, published in the preceding issue of the AMERICAN GAS ENGINEERING JOURNAL, shows every minute well filled.

While no regular gas exhibition will be held in connection with the convention, nevertheless all the main dealers in gas appliances will make special displays of their goods at the Canadian National Exhibition, and the Consumers' Gas Company will also have from eight to ten large booths exhibiting all classes of appliances—from the smallest household articles to big industrial fuel equipment. These appliances will be in operation, and will be worthy of a visit. In fact, a visit to all these exhibits is on the program. Some of the manufacturers will have special representatives in attendance.

Owing to the convention being held during the time of the Canadian National Exhibition, it will be necessary for the intending delegates to send in reservations to George W. Allen, treasurer, early.

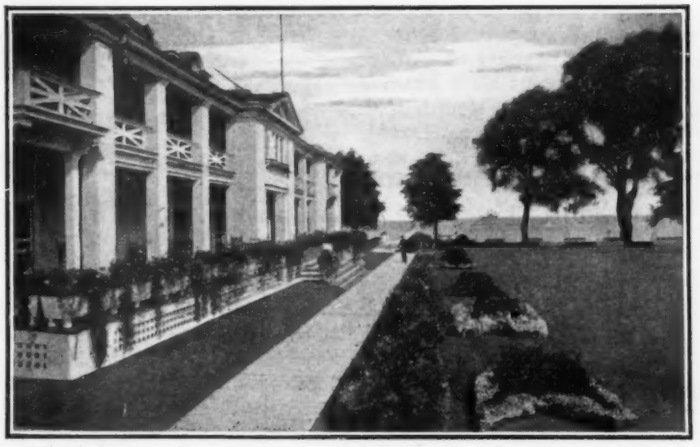
The Canadian National Exhibition had an attendance of 1,009,000 in

Points of Interest at Canadian Gas Association Convention

BELOW; FOUNTAIN AND PART OF MANUFACTURERS' BUILDING AT NATIONAL EXPOSITION

BELOW; MOTOR BOAT RACING IN FRONT OF EXPOSITION GROUNDS

ABOVE; THE HORTICULTURAL BUILDING AT THE CANADIAN NATIONAL EXPOSITION



ROYAL CANADIAN YACHT CLUB ON TORONTO ISLAND WHERE CONVENTION MEETING AND DINNER WILL BE HELD

1913. In 1914, the first War year, the number of visitors dropped to 762,000. The attendance reached 864,000 in 1915, and was back around normal in 1916—910,000 people. With so many thousand fighting men performing sterner duties abroad, it is perhaps too much to expect new attendance records in 1917, but the directors are confident they will achieve new standards in the all-around excellence of the exhibition, and have injected new enthusiasm into every department in an effort to make the program worthy the occasion it is designed to commemorate—the fiftieth anniversary of Canada.

A list of the representative Toronto hotels and rates is as follows:

King Edward Hotel, European plan, Convention headquarters, King Street East, Toronto. $1.50 per day and up, single. $2.50 per day and up, double, without bath, but with bath privileges. $2.50 per day and up, single. $4.00 per day and up, double, with private bath attached.

The Hotel Carls-Rite, American plan, opposite Union Station, Toronto. Room without bath $3.00 and $3.50 per day, each person. Room with bath $3.50 and $4.00 per day, each person.

The Walker House, American plan, Front Street, near Union Station. Room without bath, $3.00 per day per person. Room with bath from $3.50 to $4.00 per day, per person.

The Queen's Hotel, American plan, Front Street, Toronto, $3.50 per day and upward without bath, and $4.00 per day and upward with bath.

The Hotel Waverley, European plan, Spadina Avenue and College Street. Single rooms with running water, $1.00 to $2.00. Rooms with private bath, $1.50 to $2.00. Double rooms with running water, $2.00 to $3.50. Rooms with private bath, $2.50 to $4.50. Suites, two rooms with bath, $3.00 to $5.00.

The Iroquois Hotel, King Street, West, Toronto. American plan, $2.50 to $3.00 per day. European plan, $1.25 to $2.00 per day.

Doherty Safety Men Meet at New York

The mid-year meeting of the members of the safety department of Henry L. Doherty & Company, was held in New York July 10, 11 and 12. Various members of the department have come to confer with G. O. Smith, supervisor of safety of the Doherty organization. Among these are: H. L. White, traveling representative of the department, F. W. Wachter, head of the Eastern Ohio claim district and R. S. Metzger, safety supervisor of the Toledo Railways & Light Company.

Canning and Preserving August Products

Demonstration III

Demonstration Lecture to Last About One Hour and Twenty Minutes Offered by N. C. G. A.

I. General remarks on the national crisis, etc. Quotations from current food conservation propaganda. An interesting lecture at this point can be given on the use and utility of various canning and preserving devices on the market. See women's magazines, etc., for information.

II. August is the month when the largest amount of canning, preserving and evaporating should be done.

Show again the pressure cooker and the evaporating trays, explain how the washboiler with a rack that fits into the bottom gives just as good results as the pressure cooker, and show how home-made wire racks may be substituted for the commercial ones.

Talk about the making of jams especially and explain how many products may be combined in this way, as blueberries and raspberries, blackberries and apples, etc. Make the class understand that an expensive product may be "padded out" with one that is less expensive.

III. Demonstration

Canned plums.

Blueberries, huckleberries or blackberries.

Baked plum or peach marmalade.

Evaporated corn.

Recipes in the August folder.

Start with canned fruits; prepare one jar with sugar and another jar with plain water.

As soon as these are boiling, put the marmalade in the oven. Talk about the oven, its special usefulness in this regard, how there is no loss of flavor from the fruit prepared in this way, and how no time is spent in watching it as it cooks, and so on. Say that it is a very old method handed down from our great-great-grandmothers who used it in the days of the brick oven.

IV. Have the oven so slow at the end of the demonstration that you can put in the corn. Have on hand

evaporated corn to show, seal it in the bags, and cover them with the melted paraffine at some convenient time during the lecture.

V. If you work rapidly and without waste of time, it should be possible for you to make some crab apple jelly if the juice is already strained. Explain the use of the candy thermometer and also the practical test for jellying. If you have any special test that you care to use, do not hesitate to introduce it. Remember that your own personality and your own experience must always help you in working out a demonstration and securing conviction. Do not under any circumstances deviate from the methods of canning given in the recipes, or you are apt to have a failure.

VI. Explain how the jam can be made from jelly pulp (see the directions under currant jelly in the July folder). Have on hand a jar or two to exhibit and, if possible, permit the class to sample the jam.

VII. By this time the canned foods should be sterilized. Take the jars from the boiler, seal as directed, test for leakage and explain about the storage. Be sure to bring out the fact that city women need not hesitate to can just because they

have no preserving closet. Many of them will hold back on the slightest excuse, because city women have the idea that they are exempt from canning; that only their country neighbors are expected to do it. This year, every woman must can and preserve, not only for the sake of her family, but for the sake of the world in general.

VIII. Show how the jars for jelly or jam should be sterilized, and how they should be sealed with paraffine and covered with lids or with brown paper. Be sure to emphasize the fact that old sugar bowls, handleless cups, or anything of the kind can be used for the storage of jellies, jams, and fruit butters. This will save glasses.

IX. Explain how evaporated corn may be soaked for a few hours in warm water, then cooked gently and used as fresh corn in corn pudding, in soup, etc.

X. Suggest some little afternoon tea menus wherein these jams, jellies, and marmalades which have been shown in the three demonstrations may be utilized. As a side line, show a tray set for a piazza luncheon, with a cool drink and sandwiches, utilizing some of these canned products. Although things of this sort mean a little extra work for you, they will repay your effort by stimulating your class to greater activity and enthusiasm, even in hot weather. This year, every woman who has a knowledge of domestic science is indeed privileged, for she is helping her country to educate the American housewife, and this is the greatest work that can be done.

XI. Answer questions. Encourage the women to tell their experiences and to report on their results.

Bridgeport Gas Company Discontinues Wholesale Rebates

The Bridgeport Gas Light Company of Bridgeport, Conn., announced the discontinuance of such quantity discounts as bring the net price of gas below 85 cents per thousand cubic feet, July 11.

This action affects consumers of more than 30,000 cu. ft. a month only, there being no change in the schedule of discounts up to that point. Those accounts above 30,000 cu. ft. per month will be subject to the 15 cents a thousand quantity discount. There is no change in the billing price of $1.10 per thousand nor in the cash discount of 10 cents per thousand for payment by the tenth of the month. There will be a minimum charge of 50 cents a month for each meter. The new rates become effective August 1.

The announcement expresses the hope that the raise will be merely temporary and that the decrease in the price of coal and oil will permit a return to the old schedule of discounts that has been in operation for the past two and a half years.

May Utilize By-Product Plant at Norfolk

The cheaper gas committee of the City Council of Norfolk, Va., met July 9 and agreed upon the wording of a letter to be sent to W. H. Venable, Norfolk attorney for the City Gas Company, asking what price the company will put on gas supplied to its holders by a manufacturing concern producing gas as a by-product. The letter asks the price at which the company will distribute the gas if it is supplied to its holders by the manufacturing concern at 15 cents per thousand cubic feet, and asks a similar question if it is supplied at 20, 25, 30, 35 or 40 cents.

The letter set forth that a reply was desired within ten days because the committee must make a report to the Council before the end of the month.

Letters from the manufacturing concern which desires to sell by-product gas bring the information that offers have been received from other large Southern cities with which the company has been in communication and that Norfolk's decision in the matter is desired at an early date.

The cheaper gas committee has been in correspondence with the manufacturing concern for some time. The company, which is a large one, promises an investment in Norfolk of several million dollars and the employment of several thousand men. It offers to sell this gas either to the city or the City Gas Company at a figure to be fixed by negotiations. The gas is to be delivered to the holders for distribution which is to be arranged by the city or company purchasing it.

Drumright, Okla., Company Changes Name

The name of the Drumwright Ice & Light Company has been changed to the Oklahoma Gas & Electric Company, under which it will be officially known hereafter, acording to an announcement made July 9, by W. B. Miser, manager of the company. The new name has been officially registered with the Secretary of State at Oklahoma City. The change was made to conform to an order issued by the H. M. Byllesby Company, which gives all of its companies in Oklahoma the same name.

Personal Notes

FRED ROBINSON, who has been employed by the Norwich (Conn.) Gas & Electric Light Company, has applied for admission to the second camp of the Officers Reserve Corps. Mr. Robinson has served in the State Militia of Massachusetts, in the Spanish-American War, in the Philippines, and in the present war in the Battle of the Marne.

HENRY GEORGE MATTHEWS, general manager and assistant to the president of the Quebec (Canada) Railway, Light, Heat & Power Company, Ltd., died recently. Mr.

Matthews held this position for the past six years, prior to this having been general manager of the Marconi Wireless Telegraph Company of Canada. Up to the time of his death Mr. Matthews was president of the Lotbiniere & Megantic Railway Company and director of subsidiary companies of the Quebec company. He was also a director and president of the finance committee of the Young Men's Christian Association.

JAMES SHORTALL has recently been promoted by the Old Colony Gas Company, Braintree, Mass., to the position of inspector, taking in the districts of Rockland, Abington and Whitman.

THE NORTHERN INDIANA GAS & ELECTRIC COMPANY employees at Michigan City, Ind., recently entertained as guests about 25 of the Hammond employees. A ball game was enjoyed at Doll Park in the afternoon and a supper was served in the evening at the Elston Hotel.

JOHN A. BRITTON, vice-president and general manager of the Pacific Gas & Electric Company, San Francisco, Cal., has accepted a position on the committee in charge of the French wounded emergency fund.

THOMAS G. HENDERSON, sales-manager of the North Adams (Mass.) Gas Light Company, in a recent competitive contest, conducted by a Pittsburgh, Pa., concern, submitted a paper on "The Best Method of Selling Automatic Water Heaters" and won first prize, which is a cash prize. Mr. Henderson is to be commended, as there were a large number of papers from different localities submitted.

EVERETT L. TURNER has been placed in charge of the Old Colony Gas Company's business at Whitman, Mass. He was formerly with the Metropolitan Insurance Company and is a member of the board of health.

SIDNEY W. WINSLOW, JR., has been elected a director of the First National Bank of Boston, to fill the vacancy resulting from the death of his father. Mr. Winslow is also a director of the Beverly (Mass.) Gas & Electric Company, The Salem (Mass.) Gas Light Company and several other well known concerns.

H. L. NICHOLS was elected secretary, treasurer and manager of the Minnesota Gas & Electric Company, Albert Lea, Minn., at a recent board of directors meeting, succeeding F. A. Otto, former manager, who resigned. Mr. Nichols has taken over the controlling stock of the property and assumes active management.

THE UNION GAS & ELECTRIC COMPANY employees held their annual outing at Highland Grove Park recently, at which a large gathering was present. Many athletic feats as well as a baseball game were participated in, handsome prizes being awarded the winners. W. W. Freeman, W. Y. Cartwright and T. F. Wickham were on hand to witness the events of the day, which were all carried on very successfully, due to the efforts of the arrangement committee.

Societies and Associations

THE ILLUMINATING ENGINEERING SOCIETY has completed plans for their 1917 Correspondence Convention. The committee on papers reports the following papers scheduled for inclusion: Presidential Address by W. J. Serrill; Report of Committee on Progress by F. E. Cady, chairman; Report of Committee on Nomenclature and Standards by A. E. Kennelly, chairman; The Hemisphere as an Integrating Photometer for Projectors, etc., by F. A. Benford; Color Symposium: Introductory by M. Luckiesh, Physics by H. C. Richards, Psychology by L. T. Troland, Specifications and Tests by I. G. Priest, Color in Illumination by Beatrice Irwin; Importance and Value of Illuminating Engineering to Central Stations by Thos. F. Kelly (Auspices Lighting Sales Bureau, N. E. L. A.); Application of Illuminating Engineering to the Gas Industry by R. ff. Pierce (Auspices N. C. G. A.); Growth and Present Status of Systems used in the Maintenance of Gas Lamps in Residences by E. B. Myers; Lighting of Independence Square, Philadelphia, by E. F. Kingsbury; Lighting of Textile Mills by G. Wrigley; Economics in the Operation of Large Lighting Installations by C. L. Law and J. E. Buckley; Illumination Intensities in Some of the Large Department Stores in New York City by W. F. Little and J. F. Dick; Illuminating Engineering Advertising by G. H. Stickney. It is planned in a few weeks to arrange these papers in groups for release during respectively September, October and November, and possibly December of 1917. Early in the month of release, copies will be sent to any one who may apply for them to the general office, and will be accompanied by invitation to submit a written discussion. The boards of managers of sections may, if they wish, utilize such papers for section meetings held in the month of release. In some cases it may be possible to have the papers presented by the authors before such meetings. Local representatives also, may, if desired, arrange for meetings in their territory, at which the papers may be presented during the month of release. At a date to be fixed, but probably about the 20th of the month, the papers will be released for publication or abstract by the technical press. All discussion of each paper during the month of release, whether delivered at a meeting or submitted in writing to the general office, will be brought together and printed with the paper in the transactions of the society. Further details will be announced later.

Construction Notes

Main Extensions by Georgetown Company

The Georgetown Gas Light Company has notified the Washington, D. C., commission that it will extend its mains in Lowell Street, between Thirty-fourth and Thirty-fifth; Livingston Street, between Thirty-ninth and Forty-first, and McKinley Street, between Thirty-ninth Street and Connecticut Avenue, if given a reasonable time and sufficient notice in advance of the paving work.

Hackensack Holder of Public Service Gas Company Completed

The large gas holder constructed for the Public Service Gas Company of New Jersey, near Dock Street, Hackensack, by the Bartlett-Hayward Company of Baltimore, has been completed. It is one of the largest in that section of the state, being 144 ft. in diameter, 177 ft. high and having a capacity of 2,000,000 cu. ft. The top of the tank is probably the highest point in Bergen County with the exception of the Palisades. The tank was filled with gas June 18.